MONSANTO INDUSTRIAL CHEMICAL CO.

Report

on

HYDROGEOLOGICAL INVESTIGATION

SODA SPRINGS PLANT SITE

Soda Springs, Idaho

VOLUME 1
Main Text

November, 1985

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Golder Associates

Golder Associates

CONSULTING GEOTECHNICAL AND MINING ENGINEERS

REPORT TO

MONSANTO INDUSTRIAL CHEMICAL CO.

HYDROGEOLOGICAL INVESTIGATION
SODA SPRINGS PLANT SITE
SODA SPRINGS, IDAHO
VOLUME 1

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EXECUTIVE SUMMARY

This report describes the program which was carried out by Golder Associates to study the hydrogeological regime underlying the Soda Springs facility of the Monsanto Industrial Chemical Company to assess if past or current operations had impacted surface or subsurface water quality.

The thorough and comprehensive approach comprised the following activities: literature search of both public and private sources of data; preliminary field studies including geological reconnaissance, pump testing, geophysical logging, water level monitoring of existing test wells; installation of new test wells on the basis of the interpretation of the preliminary fieldwork; geophysical logging and hydraulics testing of the newly installed test wells; water quality sampling of all on-site production wells and test wells, the effluent stream, some off-site wells and springs adjacent to the plant site; data anlaysis and interpretation to produce a hydrogeological model and to assess the impact of operations on ground water quality.

The program included the evaluation of data from the existing 7 test wells, 3 plant productions wells, 4 off-site wells, 5 local springs and the installation and evaluation of results from a further 31 onsite new test wells. The new test well installations comprised groups of nested test wells each completed in specific zones identified within the basalt sequence to permit sampling for water quality, water level monitoring to determine ground water flow directions and the possibility of intercommunication between monitored horizons, both naturally or as a result of existing test well installation.

Water quality sampling was undertaken using EPA's currently recommended procedures. A quality assurance quality control program was established to verify the laboratory generated water quality data.

Analysis of the geological and hydrogeological data obtained during the study indicates that a complex hydrogeological environment exists beneath the Soda Springs site. A hydrogeological model has been defined based on available geological, hydrogeological and geochemical data.

Four hydrostratigraphic zones have been recognized: a shallow Surficial Deposit Zone some 10 to 40 feet thick; an Upper Basalt Zone composed of two basalt flows and up to two or three cinder or weathered basalt interbeds totalling up to 100 feet in thickness; a Lower Basalt Zone composed of up to three basalts and three or four interbedded weathered basalt cinder zones totalling over 150 feet but decreasing markedly in places and thinning towards bedrock outcrops; and the Salt Lake Zone composed of stratified Tertiary sediments probably underlying the whole site.

Groundwater in the Upper Basalt Zone flows towards the south or southeast under hydraulic gradients between .006 and .05. It is concluded that a major hinge fault and a subsidiary fault and/or groundwater discharge zone locally influences groundwater flow within this zone. Geochemically the water in this zone is fresh except in the southwest corner of the site where there is probably a mixing with soda water emanating either from the underlying Lower Basalt Zone or from an area west of the plant site. The Upper Basalt Zone is recharged by precipitation and probably by underflow from the north and east of the site and from the underlying Lower Basalt Zone.

Groundwater flow in the Lower Basalt Zone is considered to be predominantly to the south with localized southwesterly or south easterly components under hydraulic gradients between .006 and 0.03. As with the zone above, the faulting and the regional ground water discharge area seems likely to influence the ground water flow pattern although the local effects cannot be precisely determined. Geochemically both fresh and soda water exist in this zone; fresh in the east and sodic in the west, possibly separated by the main fault. Recharge of fresh water likely occurs by underflow from the north and northeast and from downward leakage from the overlying Upper Basalt Zone in the central part of the site. This downward leakage is probably caused by the pumping of the plant production wells. Recharge of sodic water is likely from depth or from sources west of the site.

Geochemical analysis of the groundwater from the two basalt zones has shown apparent elevated concentrations of various ions which could originate from past or present plant operations; these include fluoride, cadmium, selenium, chloride, sulphate and vanadium. QA/QC procedures carried out on the groundwater samples show that a high degree of confidence exists in the results for fluoride, chloride and vanadium. The concentrations measured for sulphate are valid but not precise and the cadmium and selenium concentrations are not accurate at low concentrations. The confidence levels in these results could change as more data becomes available. With the exception of sulfate and arsenic, the laboratory has generally performed a good job in analysing the groundwater samples.

Plotting of concentrations of the various ions within the Upper Basalt hydrostratigraphic zone show that plumes of specific ions are migrating from identifiable sources in the north-west and north-central areas of the site towards the southeast. These sources may be identified as the northwest pond, the old underflow solids pond and the old hydro-clarifier. For chloride, sulphate and vanadium a source also appears to exist east of the plant site but more data would be required to confirm this apparent source.

When ion concentrations are plotted for the Lower Basalt Zone, there is apparently only one source; the area of the old underflow solids ponds as indicated by the fluoride and cadmium concentrations. There is a downward component of hydraulic gradient in this area that may be responsible for the presence of those ions in the Lower Basalt

Zone. It is also possible that poor test well construction practices in the past are also responsible for the presence of these ions in the Lower Basalt Zone. Statistical methods carried out on the water quality results largely confirm the data plots described above for both zones.

Solute concentration ratios indicate that chloride, sulfate and fluoride are migrating along the flow paths with similiar mobilities. Cadmium and selenium are less mobile within the groundwater system. Fluorite saturation indices indicate that the ground waters of the Upper Basalt Zone are oversaturated with respect to fluorite immediately downgradient of the old underflow solids ponds, northwest pond and old hydroclarifier. The groundwaters of the Lower Basalt Zone are oversaturated with respect to fluorite at TW5. The percolating source effluents are considered oversaturated with respect to fluorite leading to the precipitation of fluoride compounds within the vadose zone and in the aquifer immediately downgradient of the source areas. These fluoride compounds could be redissolved and remain in the groundwater system in the short term (months to several years) even if the sources are removed.

Cadmium carbonate is undersaturated in all groundwaters. There is however the possibility that the cadmium source effluents from the old underflow solids pond and northwest pond are oversaturated with respect to cadmium carbonate. Cadmium carbonate could be precipitated in the vadose zone or aquifer underlying these source areas. The potential exists for this cadmium carbonate precipitate to be redissolved and remain in the local groundwater system over the next several years. speculatio

The following conclusions may be drawn from the study:

- the hydrogeological model is complex but results from newly installed test wells have identified three on-site sources of various ions and one apparent off-site source.

- plumes of specific ions in the Upper Basalt Zone show south south eastward movement from the identified on-site sources in the overall direction of groundwater flow.

- the apparent plume in the Lower Basalt Zone could be due to downward flow from the Upper Basalt Zone as a result of production well pumpage and/or due to faulty construction of test well TW5.

- confidence levels in the concentration of specific ions is variable; high confidence exists for fluoride, chloride and vanadium; poor confidence exists for cadmium and selenium at very low concentrations; and poor confidence exists at all concentrations for sulfate.

- there is very poor confidence in the data available from the test wells existing prior to this study.

- unless there are changes in physical conditions, the identified sources will likely continue to impact the groundwater system over the next few years.

- the plant production wells may have increased groundwater velocities in the central area of the plant site and prevented or reduced further southward migration of specific ions.

- the plant production wells may be responsible for the downward vertical components of hydraulic gradient seen in the central portion of the plant site.

- based on the limited available data, the new underflow solids ponds do not appear to be impacting the groundwater system.

- the future distribution and concentration of ions cannot be accurately projected at this time due to the limited number of sampling periods (2) in the new reliable test wells.

1.0 INTRODUCTION

1.1 General

This report contains the details, results and conclusions of a hydrogeological study carried out at the Soda Springs facility of the Monsanto Industrial Chemical Company (Monsanto) located in southeastern Idaho (Figure 1.1). The overall objective of the study was to provide Monsanto with a definition of the hydrogeological environment at the Soda Springs facility for the purpose of assessing if past and/or current operations could impact surface/subsurface water quality.

1.2 Terms of Reference

In response to a "Request for Proposal" issued by Monsanto, dated April 3rd, 1984, Golder Associates submitted a proposal, number P84-1038 dated April 19th, 1984, to assess the basic hydrogeology at the Soda Springs plant. Subsequently, a revised proposal was submitted by Golder Associates dated May, 1984. Verbal authorization to proceed with a limited component of the study was given to Golder Associates in early June, 1984. Authorization to proceed with subsequent phases of the work was given under contract number C-41-84, dated June 15th, 1984.

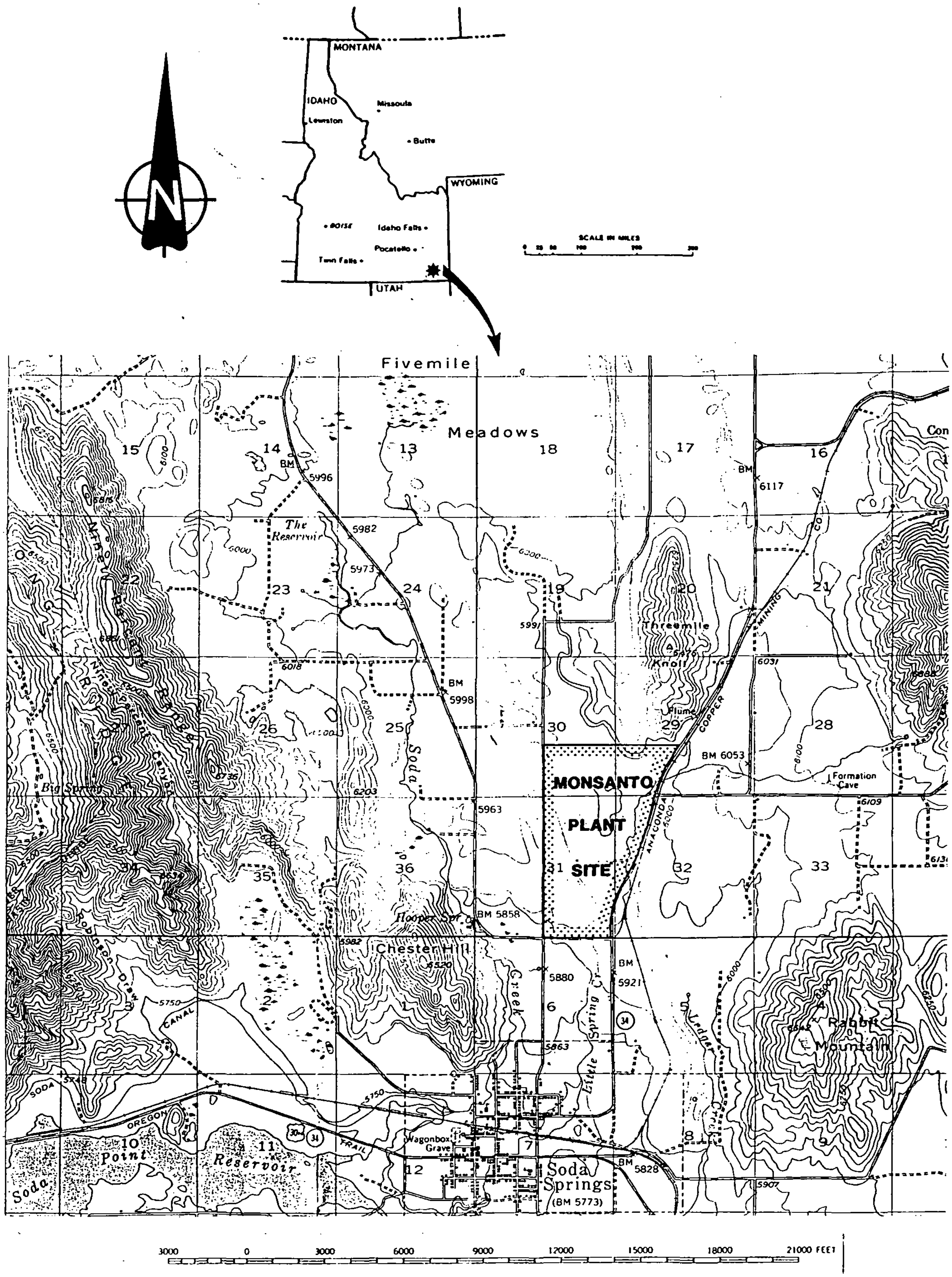
1.3 Scope of Work

The work carried out by Golder Associates to assess the hydrogeology of the Soda Springs plant site consisted of the following:

- A literature survey to develop a geological, hydrogeological and hydrogeochemical data base of the Soda Springs region, local area and plant site proper. Data were collected from both published and private sources.

LOCATION PLAN

Figure 1.1



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- Preliminary field studies to expand the data base for the plant site area an to obtain cost-effective data necessary to develop a conceptual model(s) of the hydrogeological environment. This information was used to plan the location and depth of further drilling and test well construction required to clarify the hydrogeology of the plant site. The preliminary studies consisted of four subtasks:

  - geological and aerial reconnaissance of the plant site and surrounding region,
  - pump testing of the existing test wells and plant production wells,

- Installation of new test wells at locations recommended following the interpretation of the preliminary field studies data. As the data base was expanded and the conceptual hydrogeological model(s) was refined, additional drilling sites were located and test wells were installed to refine the conceptual model(s).

- Additional field studies on the newly constructed test wells. This work consisted of:
  - geophysical logging of new test wells,
  - pump testing and/or short duration airlift testing on most of the new test wells,
  - water quality sampling of all test wells, plant production wells, the effluent stream, some off site wells and springs adjacent to the plant site, and
  - frequent water level measurements in all test wells.

- Data analysis and interpretation to produce a conceptual hydrogeological model(s) and to assess the potential impact of the plant site operational practices on the surface/subsurface water quality. This work consisted of an assessment of all data assembled during the study.

1.4 Acknowledgements

Golder Associates would like to thank Monsanto and the Soda Springs plant personnel for their cooperation and assistance in accomplishing this study. Special appreciation is given to Mr. T.S. Oliver (Senior Environmental Engineer, Soda Springs), Mr. W.K. Condie (Environmental Engineering Supervisor, Soda Springs) and Mr. R.L. Biggerstaff (Principal Engineering Specialist, St. Louis) for their technical and logistical support.

2.0 SITE CONDITIONS

2.1 Introduction

The purpose of this section of the report is to present the results of the literature survey. The survey was conducted to develop a geological, hydrogeological and hydrochemical data base for the study area prior to undertaking detailed investigations of the plant site proper. Information presented in this section has been drawn from published and unpublished reports, including Monsanto in-house records. A complete bibliography is included in a separate data volume accompanying this report.

A visit was made to the Monsanto plant site in July 1984 to assemble and review available in-house records. These records consisted in part of well logs, well water levels, pumping rates and hydrochemical data from a number of existing test wells, TW2 to TW8, and plant production wells, PW1 to PW3 (test well TW1 was damaged and thus abandoned soon after completion in 1975). Monsanto's internal records, reports, memoranda and previous pertinent consultants' reports were also reviewed during the visit.

Published geological and hydrogeological data on the Soda Springs region were gathered from a computer based reference search ("Georef") and from Idaho State University, the University of Idaho, Idaho Department of Water Resources and the U.S. Geological Survey. In addition, black and white aerial photographs of the Soda Springs area (1:20,000 scale) were obtained for review from the ASCS-USDA Aerial Photography Field Office in Salt Lake City, Utah. These photographs are included in Volume 2.

The following subsections cover both the regional and local geology, hydrogeology and hydrochemistry of the Soda Springs Monsanto plant site area.

2.2 Geology

2.2.1 Geological Setting

The Monsanto plant at Soda Springs, Idaho, is located at the southern end of the Blackfoot Lava Field in Southeastern Idaho, Figure 2.1a. The Blackfoot Lava Field occupies a generally north-northwest to south-southeast trending basin bordered on the west by the Chesterfield Range and the Soda Springs Hills, and to the east by the Aspen Range. The average elevation of the basin floor is approximately 6100 ft. Elevations of the surrounding ranges vary from over 6800 ft to nearly 7400 ft. A few scattered topographic highs occur on the basin floor as cinder cones, rhyolite domes, or up-faulted blocks. China Hat (a rhyolite dome), located at the north end of the Blackfoot Lava Field, is the most prominant topographic feature in the basin, with a summit elevation of 7164 ft. Threemile Knoll, located immediately northeast of the site appears to be an up-faulted block (horst structure). The knoll has a summit elevation of 6475 ft.

2.2.2 Stratigraphy

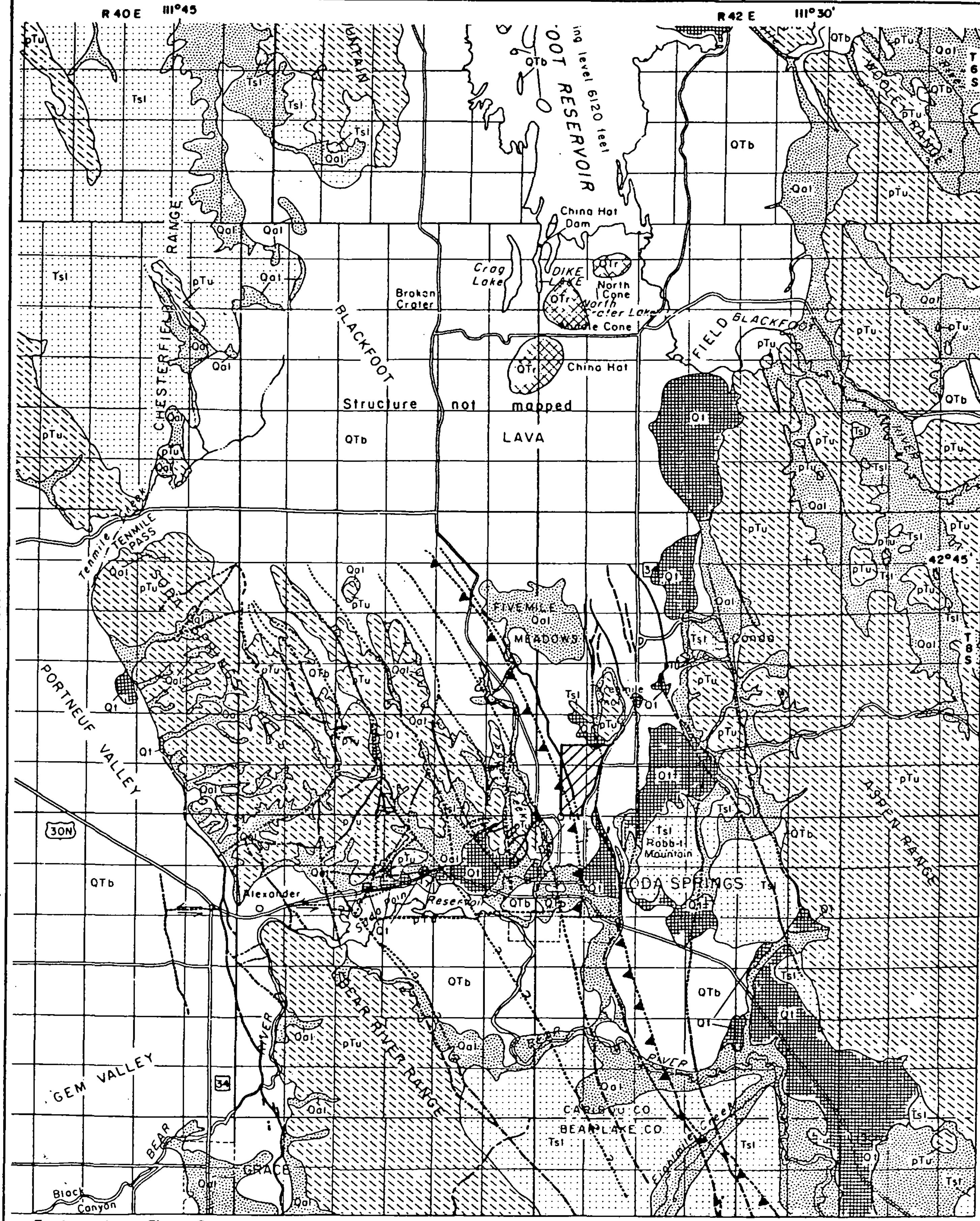
2.2.2.1 Regional

The Blackfoot Lava Field (Figure 2.1a) is a thick sequence of basalts of probable mid-Pleistocene age. Well logs indicate the basalt to be at least several hundred feet thick in the center of the Field, but thinning at the edge of the Field where the basalt laps onto older rocks (e.g. Threemile Knoll). Armstrong (1969) and Mabey and Oriel (1970) indicate that the basalt may be locally as much as 1000 ft thick.

The basalt lies unconformably over the Salt Lake Formation of Tertiary age (Armstrong, 1969). This formation is known to consist of sandstones, conglomerates and limestones, all of which may be tuffaceous.

GEOLOGY OF THE SODA SPRINGS REGION

Figure 2.1a



For legend see Figure 2.1b

0 1 2 3 4 5 MILES

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LEGEND FOR GEOLOGY MAP

Figure 2.1b

STRATIGRAPHY

EXPLANATION

QUATERNARY
- Qal — Alluvium
- Qt — Tufa

TERTIARY AND QUATERNARY
- QTb — Basalt
- QTr — Rhyolite

TERTIARY
- Tsl — Salt Lake Formation

PRE-TERTIARY
- pTu — Bedrock, undifferentiated

Contact

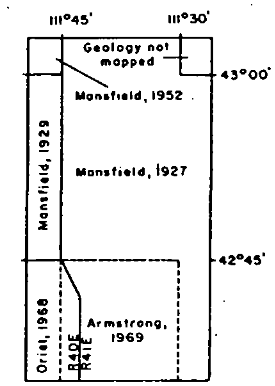
Fault
Dashed where approximately located or inferred; dotted where covered; queried where doubtful.

Concealed thrust fault
Sawteeth on side of upper plate

Linear feature on photograph
May coincide with or be extensions of mapped faults; all are interpreted as faults

MONSANTO PLANT SITE

MAP INDEX



INDEX TO GEOLOGIC MAPPING (NOT TO SCALE)

Source: United States Dept. of Interior, Geological Survey and Idaho Dept. of Water Administration. Map modified from Dion, 1974.

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The Salt Lake Formation in turn overlies rocks of Permian and Carboniferous age. These older rocks are exposed along the flanks of the Blackfoot Lava Field: limestones and sandstones of the Chesterfield Range Group to the west and the calcareous sandstones and limestones of the Wells Formation to the east (Aspen Range). A generalized stratigraphic column for the Bear River Range of Southeastern Idaho is shown in Table 2.1.

2.2.2.2 Local

Subsurface data from well drilling carried out prior to 1984 at the Monsanto plant site indicates that the site is underlain by 3 to 18 ft of clayey overburden. Beneath the overburden, possibly four distinct basalt flows totalling nearly 240 ft are present. The basalt flows appear to be separated by 2 to 10 ft thick cinder zones. Individual basalt flows appear to range from nearly 100 ft thick to less than 10 ft thick. Data from TW1 and TW2 indicate that the basalt thins towards the northeast as it laps onto Threemile Knoll. Test well TW2 encountered 224 ft of basalt and cinders overlying "a white and yellow formation", inferred to represent the Salt Lake Formation. TW1 encountered 45 ft of basalt and cinders overlying 255 ft of sandstone, shale and clay.

2.2.3 Structural Geology
2.2.3.1 Regional

The study area is situated in a transition zone between two distinct structural geological provinces. To the east lies the overthrust belt which is part of the Cordilleran Mountain system in Western Wyoming, Southeastern Idaho and Northern Utah. The overthrust belt is characterized by folds overturned to the east and gently west dipping thrust faults. The structural province to the west is the Basin and Range Province, which extends to Eastern California and Oregon. The Basin and Range Province is characterized by generally north striking, high angle normal faults which have produced major horst ranges and graben valleys.

TABLE 2.1

STRATIGRAPHIC COLUMN FOR BEAR RIVER RANGE AND SURROUNDING AREAS, SOUTHEASTERN IDAHO

(After Ralston et al., 1983)

SYSTEM	GROUP OR FORMATION	THICKNESS (m)	LITHOLOGY
Quaternary	Stream alluvium Terrace gravels Landslide debris Alluvial fan deposits Coluvium Diamictite	0-100	Unconsolidated, well to poorly sorted, gravel, sand, silt and clay.
	Travertine		
	Gentile Valley Group Gem Valley basalt	0-1000(?)	Dark grey, vesicular, porphyritic, massive olivine basalt.
	Basalt cinders		Loose scoriaceous red-weathering cinders.
	Main Canyon formation	0-20	Poorly consolidated silt and marl, grades into sand and gravel.
	Lake Bonneville Group Provo Formation	0-30	Unconsolidated gravel and sand deposited along shoreline of Lake Bonneville in the Provo stage.
	Pink silt	?	Unconsolidated, thinly bedded silt and clay in deeper parts of Lake Bonneville.
	Bonneville and Alpine Formations, undifferentiated	0-30	Poorly consolidated gravel and sand deposited along shoreline of Lake Bonneville in the Alpine and Bonneville stages.
	Rhyolite domes	?	Tan weathering, partly devitrified glass, Quarternary and Tertiary.
Tertiary	Salt Lake Formation	0-3000(?)	Conglomerate, volcanic ash, marl, calcareous clay and sandstone.
	Wasatch Formation	0-450	Red conglomerate and sandstone interbedded with tan limestone.
Upper Jurassic	Stump Formation	50-100	Grey-green silty limestone, calcareous siltstone and sandstone.
	Pruess Formation	0-200	Red shaley sandstone and siltstone.
	Stump/Pruess Formations, undifferentiated		
Middle Jurassic	Twin Creek Formation	200-500	Dark grey shaley limestone, oolitic limestone and siltstone.
Lower Jurassic	Nugget Formation	100-500	Reddish-brown, well-sorted, fine grained sandstone.
Upper Triassic	Ankareh Formation	90-200	Red calcareous shale and siltstone.
Lower Triassic	Thaynes Formation	250-300	Upper Member - grey limestone interbedded with brownish-grey siltstone; Middle Member - brownish-grey siltstone and silty limestone; Lower Member - black to grey shale and siltstone.
	Woodside Formation	100-400	Reddish-brown siltstone and shale.
	Dinwoody Formation	100-600	Upper Member - grey limestone interbedded with olive-brown siltstone; Lower Member - olive-brown calcareous siltstone interbedded with grey limestone.
Permian	Phosphoria Formation	70-100	Rex Chert Member - black to white chert interbedded with black cherty mudstone; Phosphatic Shale Member - dark-brown to black mudstone, limestone and oolitic phosphate rock.
Pennsylvanian	Wells Formation	300-900	Upper Member - light grey to reddish-brown sandstone interbedded with light brown limestone; Lower Member - grey limestone and silty limestone with interbedded sandstone.
Mississippian	Mission Canyon Formation	300-800	Light to dark grey cherty limestone and dolomite.
	Lodgepole Formation	200-400	Dark grey limestone and dolomite.

2.2.3.2 Local

The plant site is located within a structural depression known as the Bear River Valley graben. A series of north-northwest striking normal faults (Armstrong, 1969; Oriel and Platt, 1980) extend from just south of the Monsanto site to that portion of the Blackfoot Lava Field located between Reservoir Mountains and Blackfoot Reservoir. These normal faults exhibit both west-side-down and east-side-down relative displacements. The westernmost fault within this zone apparently enters the Monsanto site near the northwest property corner and appears to exit the property approximately 600 ft west of the southeast corner. The apparent fault is expressed on the surface as a southwest facing scarp which extends from the southwest corner of Fivemile Meadow southeastwards to an area approximately 1/2 mile south of the site (Figure 2.1a).

Armstrong (1969) indicates that the Monsanto site may be underlain at depth by an extension of the Paris Thrust Fault. The fault apparently does not displace the Pleistocene basalts, nor the underlying Salt Lake Formation.

2.3 Hydrogeology

2.3.1 Hydrogeological Setting

The plant site is located within the Bear River drainage basin. The northern boundary of this drainage basin is the Blackfoot reservoir, located some 12 miles north of the plant site. Soda Creek drains the basin and has its source in the area of Fivemile Meadow, some 3 miles northwest of the Monsanto plant site. Soda Creek drains southwards close to the western edge of the Blackfoot Lava Field, entering Soda Point Reservoir west of the town of Soda Springs. Numerous springs exist on both the eastern and western edge of the Blackfoot Lava Field. Some springs are carbonated and have been termed "soda" by local inhabitants.

In general, the Pleistocene basalts occupying the valley floor are a very productive aquifer (Dion, 1974), yielding large amounts of ground water (500 to 3000 gpm). The underlying sandstone, conglomerate and limestones of the Salt Lake Formation and the surrounding Permian and Carboniferous rocks yield varying amounts of ground water (0 to 1500 gpm) but are highly unpredictable as a source for water supply.

2.3.2 Regional Ground Water Systems

Studies by Dion (1974), Hutsinpiller (1979), Ralston et al. (1983) and Seitz et al. (1979) have inferred three dominant flow systems in the Soda Springs region. The three flow systems are:

(1) The Shallow Ground Water System moving locally through the upper elevations of the basaltic lithologies,

(2) The Mead Thrust Aquifer System which discharges along the eastern margins of the valley, and

(3) The Chesterfield Range Aquifer System which discharges along the western portions of the valley.

Each flow system passes through unique stratigraphy and has different contact time with the rock and, as a result, has unique hydrochemical characteristics.

2.3.2.1 Shallow Ground Water System

This system flows through the upper stratigraphic unit of the basalts and surficial Quaternary alluvium. Ground water flow within the basalts is considered to be principally between the individual lava flows, where rubbly cinder zones or interflow sediments at the top of a flow were not filled completely by the succeeding flow. However, fault zones, vertical joints and fractures provide permeable pathways within and between the individual basalt flows. Ground water flow in the alluvial deposits is limited, since the soils are predominantly silty and often unsaturated.

The shallow ground water system is recharged principally by infiltration of meteoric water and by leakage from the Blackfoot Reservoir. Dion (1974) estimated that approximately 5000 gpm of reservoir water was leaking into the underlying basalt aquifer and moving southward. Discharge from this flow system is to Soda Creek, Soda Point Reservoir and downvalley within the basalt sequence itself towards the Bear River.

The ground water within this flow system comes into contact with surface soils and basaltic stratigraphic units. The water quality is characterized by low dissolved solids (generally <500 mg/l), low P_{CO_2}, moderately oxidizing, calcium/magnesium ratios greater than 1.0 and generally elevated nitrate concentrations (>5 mg/l). The water is considered to be young due to the suspected local flow system and the low total dissolved solids.

2.3.2.2 The Mead Thrust Aquifer System

This system is apparently recharged by precipitation over the mountains to the east of the Monsanto plant site, which include the Aspen Range, Schmid Ridge, Dry Ridge and Webster Range (Ralston et al., 1983). Ground water flow is apparently westward along permeable sedimentary beds with the Mead Thrust Fault possibly acting as a hydraulic conduit for much of the flow. Discharge from the flow system is apparently along the eastern side of the Blackfoot Lava Field via deep, high-angle vertical extension faults. Numerous springs exist on the eastern margin of the Lava Field and, apparently, mixing occurs with ground water of the shallow ground water system.

Carbon 14 dating of spring water obtained from the eastern margin of the Blackfoot Lava Field indicates that the ground water is approximately 10 to 20 thousand years old. The discharging ground water is calcium-bicarbonate type (high P_{CO_2}) water which results from the limestone country rock and long contact times. Most of these springs are saturated with respect to calcite. Fluoride ranges from 0.1 to 1.7 mg/l and total dissolved solids range from 600 to 1700 mg/l. (Ralston et al., 1983).

2.3.2.3 The Chesterfield Range Aquifer System

The recharge for this flow system is unknown, but it probably receives recharge from the Chesterfield Range to the west of the Monsanto plant site. These mountains have a dominant limestone lithology, but are not the same formations composing the mountains to the east of the plant site. Ground water within this flow system probably flows eastwards, discharging along the western side of the Blackfoot Lava Field through deep, high-angle vertical extension faults, where it may mix with ground water of the shallow ground water system.

Spring discharges along the western side of the Blackfoot Lava Field are characterized by magnesium-bicarbonate type (high P_{CO_2}) water with dissolved solids contents around 900 to 1300 mg/l. These waters usually contain elevated concentrations of iron (greater than 5 mg/l), have fluoride concentrations of between 0.1 amd 0.4 mg/l, and are weakly oxidizing in nature. Age dating of this water has not been done. However, since the flow system is considered to be regional and the total dissolved solids is relatively high, the water is likely old.

2.3.3 Local Ground Water Systems

Within the immediate plant site vicinity, information on the local ground water flow systems is available from well drilling records, water level monitoring data and from well and spring water quality analyses.

The locations of the test wells, plant production wells and springs are shown on Plate 1. Past well drilling records are questionable due to the lack of hydrogeological supervision during drilling and well completion. Water levels in the plant production wells are monitored once a month, while water levels in the test wells were recorded only a few times prior to this study. Detailed hydrochemical data from the existing test wells, plant production wells, off site wells and springs are available on a quarterly basis for the period of record, as shown on Table 2.2. These chemical data suggest two distinct ground water flow systems and appear to be equivalent to the shallow ground water system and the Chesterfield Range aquifer system.

2.3.3.1 Shallow Ground Water System

Water quality analysis on samples collected from the following sources appears to fall within the Shallow Ground Water System category (e.g., low TDS, low P_{CO_2}, moderately oxidizing, calcium/magnesium ratios greater than 1.0 and generally elevated nitrate concentrations): Wells PW1, PW2, PW3, TW2, TW5, TW6, Nelson, Lewis, SWC and SWG, and Calf and Mormon springs. Many of these sources show apparent elevated concentrations of various ions: fluoride, cadmium, selenium, chloride and sulfate. The following examples (collected by Monsanto prior to this study) show ion concentrations of water samples on August 2nd, 1984: PW1 showed fluoride concentrations of 2.09 mg/l, cadmium of 0.17 mg/l and selenium of 0.053 mg/l. Test wells TW5 and TW6 both showed concentrations of fluoride in excess of 10 mg/l, cadmium greater than 0.2 mg/l, chromium greater than 0.1 mg/l and selenium between 0.04 and 0.07 mg/l. In addition, high levels of chloride and sulfate, greater than 300 mg/l and greater than 700 mg/l, respectively, were recorded in TW5 and TW6. One offsite well, SWG showed high fluoride (5.3 mg/l) and selenium (0.144 mg/l) concentrations. Offsite well SWC showed a vanadium concentration of 0.4 mg/l. Water samples from both Calf and

TABLE 2.2

PERIOD OF RECORD FOR

WATER QUALITY SAMPLING SITES

LOCATION	LENGTH OF RECORD
TW2	November 1978 to present
TW3	November 1978 to present
TW4	November 1978 to present
TW5	November 1978 to present
TW6	November 1978 to present
TW7	March 1982 to present
TW8	March 1982 to present
PW1	January 1984 to present
PW2	January 1984 to present
PW3	November 1978 to present
Lewis	November 1978 to present
SWC	September 1983 to present
SWG	July 1983 to present
Nelson	November 1978 to present
Mormon Springs	June 1983 to present
Calf Springs	September 1983 to present
Dock Springs	September 1983 to present
Hooper Springs	December 1979 to present
SW Spring	September 1983 to present

Mormon springs had fluoride concentrations of 7 to 9 mg/l and minor concentrations of selenium (0.1 mg/l).

In general, ground water quality data are available from the existing test wells, plant production wells and springs on a quarterly basis since 1979. Figures 2.2 to 2.6, inclusive, illustrate the trends in ground water quality for PW3, TW5, TW6 and SWG with respect to time for fluoride, cadmium, selenium, chloride and sulfate. It should be noted that the quality control/quality assurance (QC/QA) of sampling and analysis prior to this study, is questionable. In particular, there have been laboratory problems accurately measuring cadmium and selenium concentrations just above the limits of detection (close to the drinking water standards). Thus, the accuracy and precision of these values may be suspect. Trends are only shown for PW3, TW5, TW6 and SWG, since these wells show a significant trend and/or peaks in their water quality data. Review of these data collected prior to the present study indicate the following:

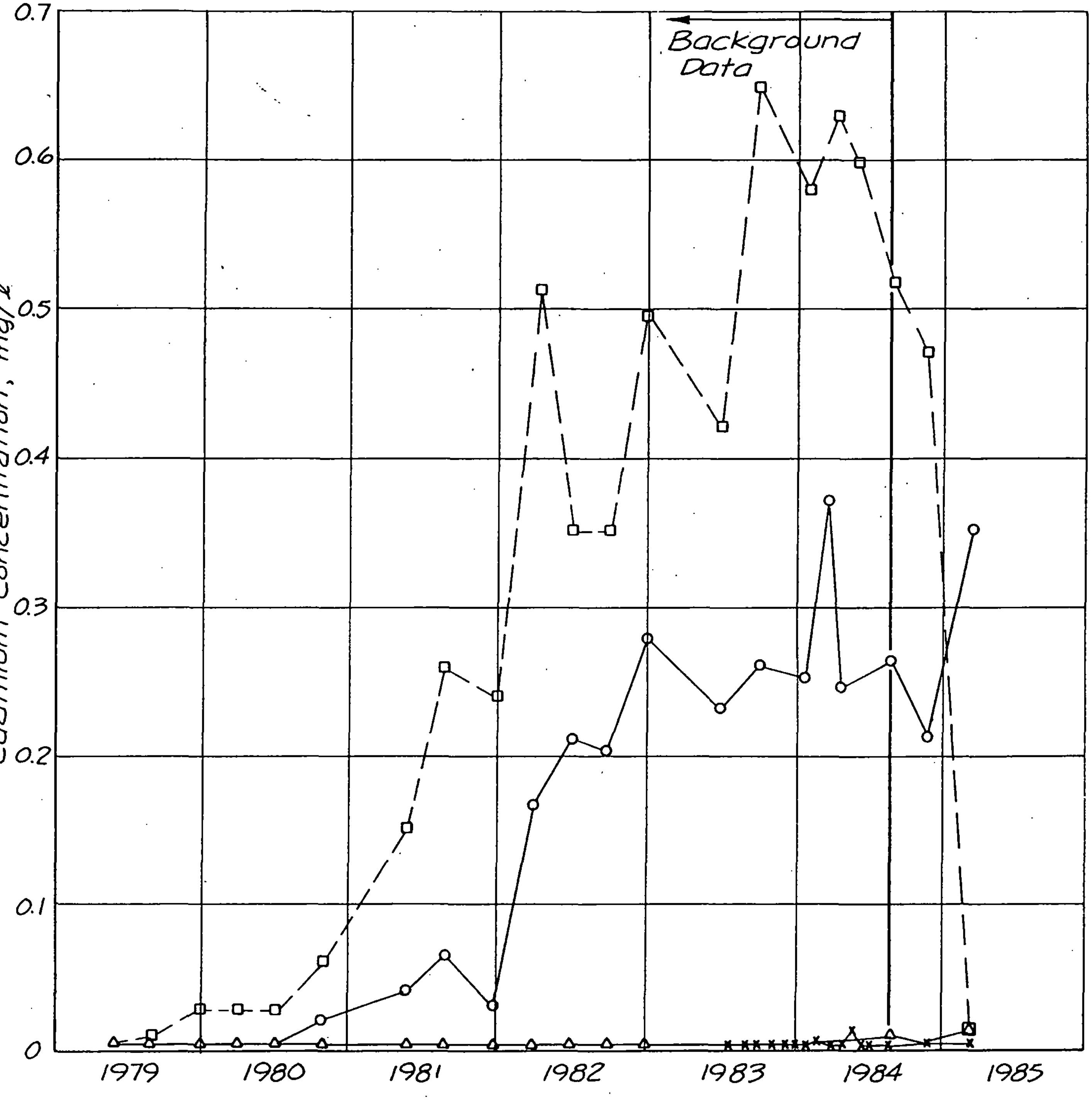
- Fluoride concentrations in TW5 and TW6 increased in the first quarter of 1982, from about 8 to 9 mg/l to about 14 to 16 mg/l. Fluoride concentrations in these test wells then declined through the end of 1983. Flouride concentrations in well SWG and PW3 have remained relatively stable. See Figure 2.2.

- Cadmium concentrations in test wells TW5 and TW6 have generally increased since 1979. The cadmium concentrations appear to have stabilized during 1983 and 1984 at approximately 0.25 mg/l in TW5 and 0.6 mg/l in TW6. Cadmium has not been detected in the SWG well and has been recorded at about .01 mg/l in production well PW3. See Figure 2.3.

- Selenium concentrations in test wells TW5 and TW6 have fluctuated between 0.01 mg/l and 0.08 mg/l. Selenium concentrations in well SWG increased in late 1983. In plant production well PW3, selenium concentrations have risen from the minimum detection limit to 0.03 mg/l in 1984. It should be noted that the selenium concentrations in plant production well PW3 have since declined and are reported (February/March 1985) at less than the detection limit of 0.005 mg/l. See Figure 2.4.

CADMIUM CONCENTRATIONS IN PW3, TW5, TW6 AND SWG

Figure 2.3



LEGEND
- △ PW-3
- ○ TW-5
- □ TW-6
- x SWG

NOTE
Cadmium drinking water standard - 0.010 mg/l

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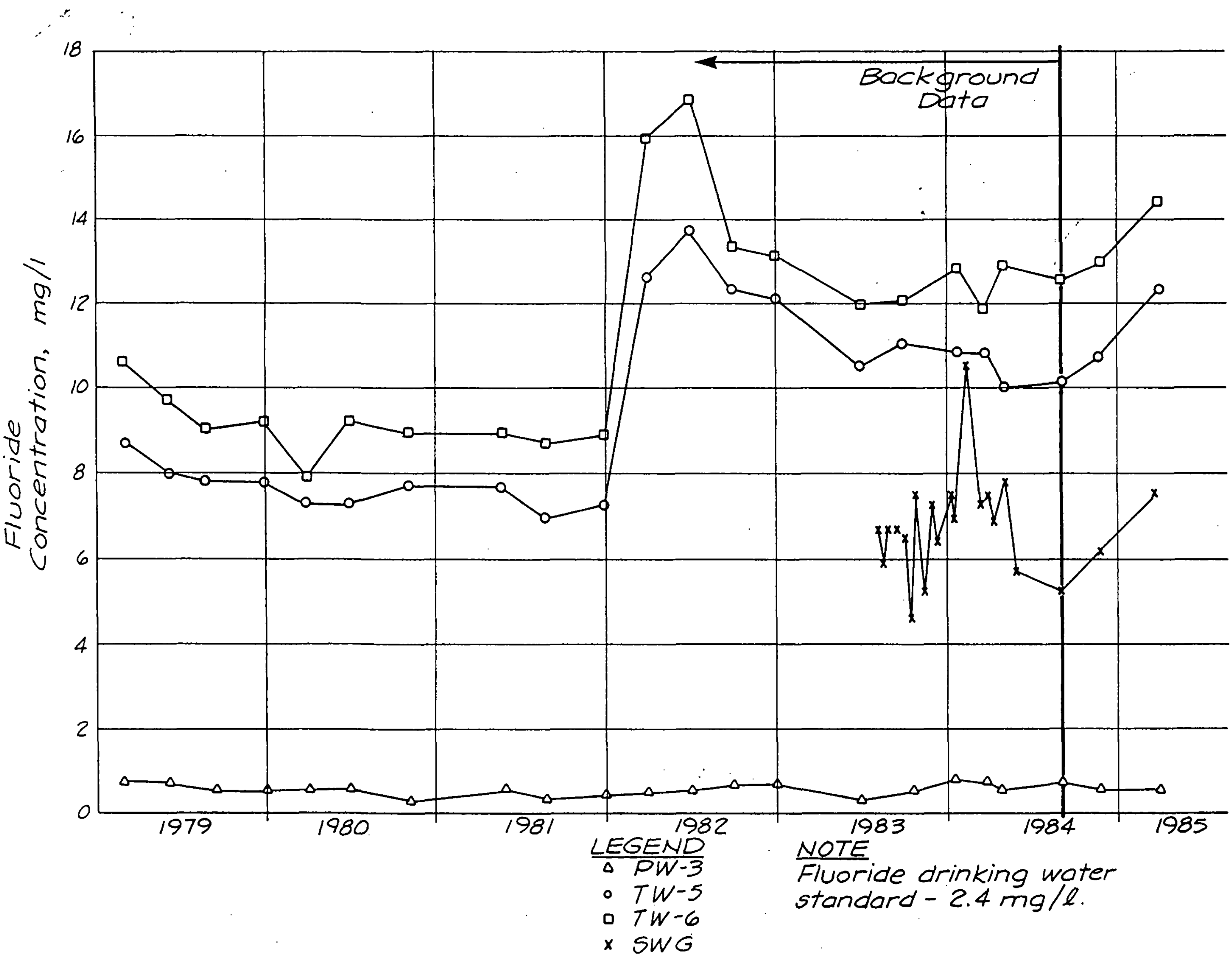
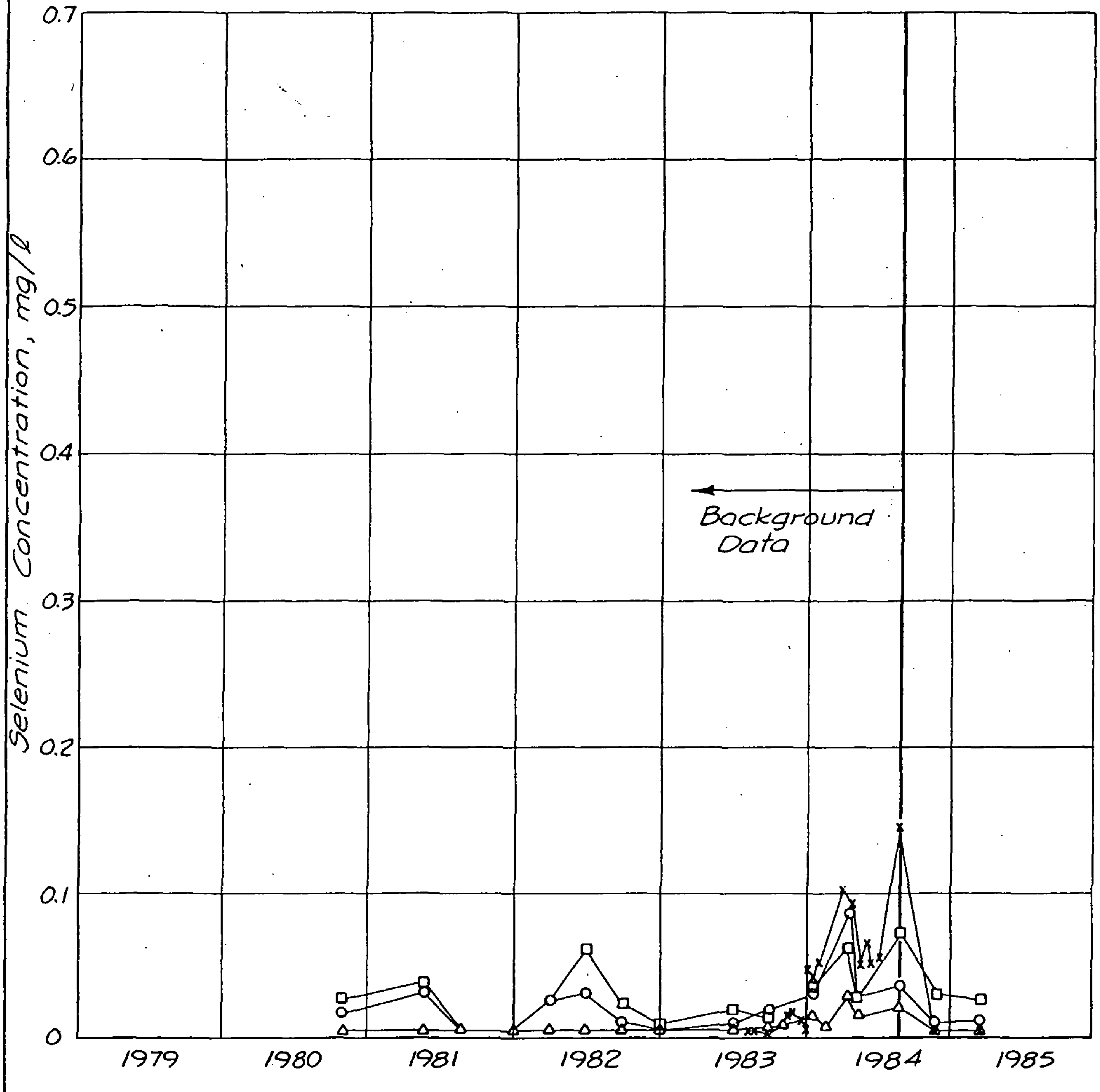


Golder Associates

FLUORIDE CONCENTRATIONS IN PW3, TW5, TW6 AND SWG

Figure 2.2

SELENIUM CONCENTRATIONS IN PW3, TW5, TW6 AND SWG	Figure 2.4



NOTE
Selenium drinking water standard = 0.01 mg/ℓ

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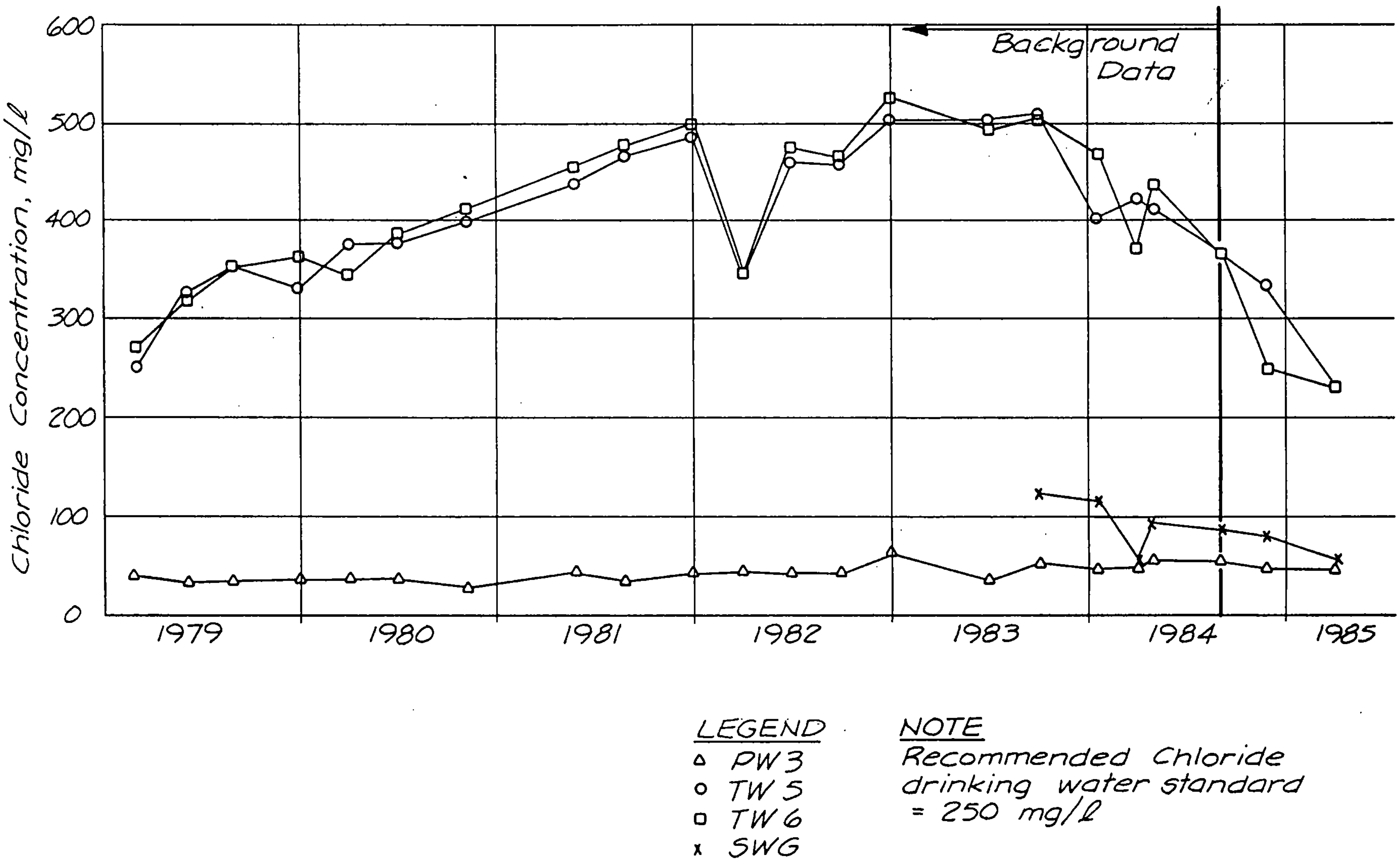
PROJECT NO. 842-1543 DRAWN R.D. REVIEWED .... DATE June '85



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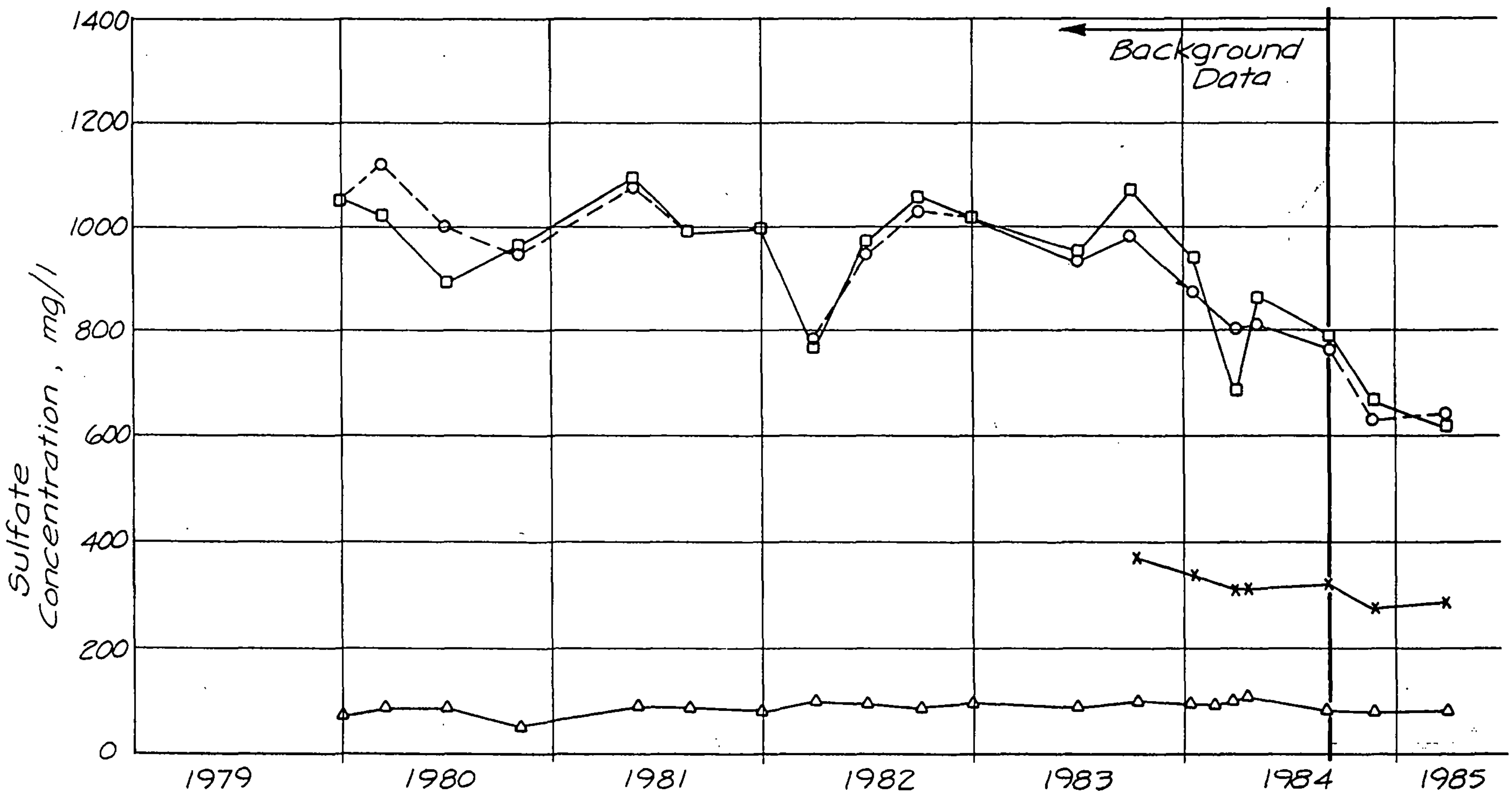
CHLORIDE CONCENTRATIONS IN PW3, TW5, TW6 AND SWG

Figure 2.5

PROJECT NO. 842-1543 DRAWN R.D. REVIEWED .... DATE May '85



LEGEND
- △ PW3
- ○ TW5
- □ TW6
- x SWG

NOTE
Recommended Sulfate drinking water standard = 250 mg/ℓ.

Golder Associates

SULFATE CONCENTRATIONS IN PW3, TW5, TW6 AND SWG

Figure 2.6

- Chloride concentrations in test wells TW5 and TW6 rose from about 300 mg/l in 1979 to about 500 mg/l in 1982-83, and subsequently declined through 1984. Well SWG shows decreasing chloride concentrations. Chloride concentrations in plant production well PW3 have remained relatively constant at about 50 mg/l. See Figure 2.5.

- Sulfate concentrations in test wells TW5, TW6 and SWG have generally declined for the period of record. Sulfate levels in PW3 have remained relatively constant between 60 and 100 mg/l. See Figure 2.6.

Of the wells installed prior to the present investigation, test wells TW5 and TW6, located immediately west and south of an old underflow solids pond, show the greatest concentrations of fluoride, selenium, cadmium, chloride and sulfate. These ponds are known to have received slurries with elevated fluoride and trace metal concentrations. The ponds are not currently used for disposal.

2.3.3.2 Chesterfield Range and Ground Water System

Water quality analysis on samples collected from test wells TW3, TW4, TW7, TW8 and from Dock, Southwest and Hooper Springs fall within the Chesterfield Range Ground Water System category (e.g., magnesium-bicarbonate type water, high TDS, weakly oxidizing and elevated concentrations of iron). In general, these waters do not contain elevated concentrations of fluoride, cadmium, selenium, chloride or sulfate. Waters from southwest spring and TW7, however, showed selenium concentrations of 0.019 and 0.013 mg/l, respectively, in August, 1984. Note that the quality control/quality assurance (QC/QA) of sampling and analysis prior to this study, which includes the aforementioned values, is questionable. Thus, the accuracy and precision of these values may be suspect.

Little change in ground water quality is observed in test wells TW3, TW4, TW7 and TW8, and from Dock, Southwest and Hooper Springs since the beginning of record in 1979. These data are presented in a separate data volume.

3.0 FIELD PROGRAM

3.1 Introduction

The field program consisted of a series of tasks as indicated in the scope of work in Section 1.4. Preliminary field studies, consisting of geological reconnaissance, well hydraulics testing and geophysical logging of existing test wells, were carried out to expand the data base of the plant site area. These data were evaluated in order to plan the number, location and depth of additional test wells required to clarify the hydrogeology of the plant site. The additional test wells were then installed, geophysically logged and sampled for water quality. Test well water levels were recorded throughout the program.

In the following subsections, the details of each individual field program are presented. Section 4.0 contains the results of the field program.

3.2 Geological Reconnaissance

A surficial geological reconnaissance of the Monsanto plant site and surrounding region was conducted on July 26th, 27th and 28th, 1984. The reconnaissance was carried out to obtain a better understanding of the local geological framework (structure and stratigraphy). The following sites were visited as part of the reconnaissance:

- The southeast side of Fivemile Meadow - where the mapped normal fault (Armstrong, 1969; Oriel and Platt, 1980) that passes through the plant site is exposed. The character of the basalt (rock texture, rock composition, joint spacing, joint continuity and joint width) and the character of the fault plane (relative displacement, strike, dip and type of fault surface) was investigated.

- The plant site area - to examine basalt exposures and the topographic expression of the mapped normal fault passing through the plant site property.

- o The south side of the Bear River east of the confluence of Bailey Creek - to examine exposures of the Salt Lake Formation and to see if the Paris Thrust Fault was exposed. The character of the Salt Lake Formation rocks was examined.

Following the surface reconnaissance, an aerial reconnaissance flight was flown in a fixed wing aircraft from Soda Springs northwards to the Blackfoot Reservoir on July 28th, 1984. The flight was flown in the early morning hours with sun angles of between 15 to 25 degrees in order to maximize the low sun angle illumination effect, and thus enhance the detection of vegetation lineaments, contrasts and scarps, possibly indicative of fault and/or ground water effects. Features identified during this flight were then field checked and identified on geological maps and aerial photographs.

3.3 Drilling and Test Well Completion

3.3.1 General

The drilling program was planned to identify the major water bearing zones to a depth of approximately 250 ft beneath the plant site. It was intended to drill the boreholes open hole at 8 inch nominal diameter after setting nominal 8 inch diameter surface casing through the surficial soils. At each drill site, the first borehole was to be drilled to the proposed maximum depth of 250 ft to identify the number of water bearing zones for the purpose of determining the number of test wells required at each location. The first borehole would be completed as a test well in the deepest water bearing zone. Subsequent boreholes would then be drilled to monitor shallower water bearing zones, if present. It was anticipated that two to three test wells would be drilled at each drill site, depending on the conditions encountered.

Four drilling companies were invited to submit bids for the drilling and installation of test wells at the Soda Springs plant site. The drilling contract was subsequently awarded in mid-July, 1984, to Andrew Well Drilling of Idaho Falls, Idaho. Drilling equipment was mobilized to the site and work started on August 17th, 1984.

Three phases of drilling were carried out:

- between August 17th and November 8th, 1984, test wells TW9 to TW30, inclusive, were installed;
- between December 3rd and 19th, 1984, test wells TW31 to TW34, inclusive, were installed; and
- between January 28th and February 18th, 1985, test wells TW35 to TW40, inclusive, were installed.

Table 3.1 presents a summary of all the test wells drilled and completed during the present investigation. The location of all test wells is shown on Figure 3.1 and Plate 1.

3.3.2 Drilling

The boreholes were drilled with a Schramm T-64 rotary drilling rig. All boreholes, except for test wells TW9, TW11 and TW12, were drilled using only air or air/water as the circulating fluid. Test wells TW9, TW11 and TW12 were drilled using air, air/water and drilling foam (a biodegradable polymer) to lift the cuttings from the borehole. Where large amounts of ground water were produced during drilling, an additional compressor was used to lift water and cuttings to the surface. Test wells TW9, TW10, TW11 and TW12 were drilled using a tricone roller bit and a downhole hammer. A faster penetration rate was achieved with the tricone roller bit and all later boreholes were drilled using this type of drilling bit.

Drilling and test well completion was continuously supervised by Golder Associates personnel. Soil and rock cuttings were obtained every 5 ft or change in lithology from each borehole and placed in plastic bags for identification. A Model G-3 geolograph mounted on the drilling rig recorded the rate of advancement of the boreholes. The instrument was used for recording drilling progress for test wells TW13 to TW34,

TABLE 3.2

TEST WELL GEOPHYSICAL LOGS

Test Well Number	GOLDER ASSOCIATES' LOGGING			WASHINGTON STATE UNIVERSITY LOGGING						
	Natural Gamma	Resistivity	SP	Natural Gamma	Resistivity	SP	Gamma Gamma	Neutron Neutron	Temperature	Caliper
TW2				X			X	X		
TW3	X			X			X	X	X	
TW4	X			X			X	X		
TW5	X			X			X	X		
TW6				X			X	X	X	
TW7				X			X	X		
TW8				X			X	X		
TW9	X	X	X	X			X	X		
TW10	X			X			X	X		
TW11	X	X	X	X			X	X		
TW12	X			X			X	X		
TW13	X	X	X	X			X	X		
TW14				X			X	X		
TW15				X			X	X		
TW16	X			X			X	X		
TW17	X	X		X			X	X		
TW18	X	X	X	X			X	X		
TW19	X	X		X			X	X		
TW20	X	X		X			X	X		
TW21	X	X	X	X			X	X		
TW22	X	X		X			X	X		
TW23	X	X	X	X			X	X		
TW24				X			X	X		
TW25	X	X		X			X	X		
TW26	X	X		X			X	X		
TW27	X	X		X			X	X		
TW28	X	X	X	X	X	X	X	X		X
TW29	X	X		X			X	X		
TW30	X	X	X							
TW31	X	X								
TW32	X				X	X	X	X		X
TW33	X	X								
TW34	X	X								
TW35	X	X								
TW36	X	X								
TW37	X	X								
TW38	X	X								
TW39	X	X								
TW40	X	X								

TABLE 3.3

SUMMARY OF BOREHOLE GEOPHYSICAL LOGS

Log Type	Log Operation	Purpose
Natural Gamma	Measures the amount of natural gamma radiation emitted by the rocks/soil.	Determination of lithology and stratigraphic correlation.
Gamma-Gamma	Records the intensity of gamma radiation from a source in the probe after it is backscattered and attenuated within the borehole and surrounding rock/soil.	Indication of relative bulk density.
Neutron-Neutron	Records the moderation of neutrons emitted from a source after collision with the borehole fluids, casing and soil/rock mass.	Indication of moisture content above the water table and total porosity below the water table.
Temperature	Provides a continuous record of the thermal gradient of the fluid in the borehole.	Indication of whether zones are contributing water or theiving water from the borehole.
Single Point Resistivity	Measures the apparent resistivity of a volume of soil or rock surrounding the tool. This log is only run in the uncased portion of the borehole below the water table.	Indication of lithology.
Spontaneous Potential	Records the natural potential developed between the borehole fluid and surrounding materials. The log is only run in uncased boreholes below the water table.	Indication of bed thickness.
Caliper	Records average borehole diameter in open borehole.	Indication of borehole rugosity, lithology. Used to provide correction for effects of borehole diameter on other logs.

3.4.3 New Test Wells

Immediately following the drilling of the new test wells, the uncased boreholes were geophysically logged by Golder Associates using portable logging equipment. The logging was carried out using Monsanto's Mineral Logging System 1500 logging unit. Natural gamma and single point resistivity logs were run open hole in all boreholes except for TW14, TW15 and TW22; the geophysical logging equipment was not available when these test wells were completed. In addition, spontaneous potential logs were run in a limited number of boreholes (Table 3.2).

Radiation logging (not available with the Monsanto equipment) was accomplished by Washington State University (WSU) upon completion of the test wells; for the most part logging open-hole by WSU was not accomplished due to equipment availability/standby cost. Completed test wells TW9 through TW29, inclusive, were subsequently logged using natural gamma, gamma-gamma and neutron-neutron tools by WSU between November 4th and 5th, 1984. TW28 was logged open hole for comparison with earlier Golder Associates open hole logs and to assess the effect of borehole rugosity (borehole roughness/diameter) on log response. TW6 was relogged by WSU for comparison with the geophysical logs run in August 1984. TW32 was logged open hole by WSU in December, 1984.

3.5 Well Hydraulics Testing

3.5.1 General

Well hydraulics testing at the Soda Springs site involved short term pump testing of existing test wells, pump or airlift testing of new test wells (well development) and testing of the plant production wells. The testing was carried out primarily for the purpose of determining aquifer hydraulic parameters (transmissivity, storativity and hydraulic conductivity). The testing was also conducted to provide information on the

TABLE 3.4

SUMMARY OF WELL HYDRAULICS TESTING

TEST WELL NUMBER	TYPE OF TEST	TEST DURATION (mins)	DISCHARGE RATE (gpm)	TEST DATE
TW2	NO TESTING CARRIED OUT			
TW3	CD	63	12.7-12.8	08/03/84
TW4	SL	17	5.6	08/02/84
TW5	CD	70	10.5	08/01/84
TW6	CD	68	9.3	08/01/84
TW7	CD	73	7.2	08/03/84
TW8	SL	8	7.3	08/03/84
TW9	SL	1.5	15	09/23/84
TW10	CD	45	15	09/20/84
TW11	A	70	10 - 15	09/17/84
TW12	A	60	10 - 15	09/17/84
TW13	A	60	10 - 15	10/08/84
TW14	A	60	20 - 25	10/08/84
TW15	A	60	25 - 30	10/08/84
TW16	A	35	10 - 15	09/29/84
TW17	A	35	2 - 5	09/29/84
TW18	A	35	5 - 10	09/29/84
TW19	B	30	1 - 2	11/13/84
TW20	A	50	50	10/18/84
TW21	A	40	5 - 8	10/18/84
TW22	A	55	20 - 25	11/02/84
TW23	A	55	15 - 20	11/02/84
TW24	A	55	3 - 5	11/02/84
TW25	A	5	<1	11/05/84
TW26	A	60	10	11/05/84
TW27	A	60	1	11/05/84
TW28	A	5	30 - 50	11/07/84
TW29	A	63	0.5	11/07/84
TW30	B	30	1 - 2	11/14/84
TW31	A	60	0.5 - 1.0	12/13/84
TW32	A	60	2	12/12/84
TW33	A	60	10	12/12/84
TW34	A	30	<0.5	12/13/84
TW35	A	55	1 - 2	02/14/85
TW36	A	50	5 - 8	02/12/85
TW37	A	60	2 - 3	02/12/85
TW38	A	35	0.5	02/12/85
TW39	A	60	20 - 25	02/14/85
TW40	A	30	<0.5	02/17/85

NOTE - Type of Test

A = Airlift Test CD = Constant Discharge

B = Bail Test SL = Slug Test

apparent hydraulic boundaries. Table 3.4 presents a summary of the well hydraulic testing accomplished.

3.5.2 Existing Test Wells

Well testing involved short term pump tests in the existing test wells in order to assess the possible hydraulic interconnection of the paired wells TW3 and TW4, TW5 and TW6, and TW7 and TW8. This information was required to determine the reliability of existing test wells for monitoring purposes. Testing was performed using the electric submersible pumps already present in each well. The wells were pumped individually for a period of about one hour, or until water level in the well reached the pump intake. Cumulative discharge volume was measured by a totalizing flow meter installed on the discharge line. A 100 ft hose was generally used to divert well discharge away from the test site. Within the pumped well, depth-to-water measurements were made at regular intervals before, during and after pumping, using an electric probe. In addition, Stevens Type F water level recorders, equipped with a Johnson-Keck SD62B sensing device, were set up on the non-pumped paired test well within the well nest (except at TW7 while pumping TW8 due to the low specific capacity of TW8) to determine if a vertical hydraulic response could be measured.

3.5.3 New Test Wells

Well development by means of airlifting or bailing was accomplished on each test well after its completion. The process of well development causes a perturbation of the water level in the aquifer. The hydraulic response was monitored in most test wells and evaluated to give a qualitative indication of hydraulic response/communication between the test wells at a well nest site. For these development tests, a 1 inch diameter air line was set in the well to near the top of the screen and water pumped out for about 1 hour by airlifting. Such pumping did not allow for direct water level measurements in the well or the use of a flow meter to measure cumulative discharge volume. Flow rates were determined by visual estimation. In most development tests, Stevens recorders were installed on adjacent test wells in a well nest in order to measure any hydraulic response induced by pumping.

Short term pump tests, were carried out on test wells TW9 and TW10 to determine the transmissivity of the screened zones and to monitor the hydraulic response in adjacent test wells. The submersible pump from test well TW7 was used to pump test both wells. The pump was set to the bottom of the well (24 ft) in TW10 and to a depth of 40 ft below ground surface in TW9. Test well TW9 was pumped for approximately 1.5 minutes at a rate of 15 gpm before the pump broke suction. The pump was turned off and the well allowed to recover. TW10 was pumped for approximately 45 minutes at 15 gpm before the pump was turned off and the well allowed to recover. The pump discharge was measured by recording the time required to fill a two gallon pail. Depth to water measurements in the pump well were made using an electric probe. Stevens Type F water level recorders monitored the response in test wells TW7 and TW8.

A 24 hour airlift test was conducted in TW-20. The test was carried out to understand better the hydrogeological system in the area of TW20 where fluoride concentrations of 3 to 4 mg/l were recorded during drilling. Pumping was carried out using an air line set in the well to a depth of 35 ft below ground surface. The flow rate was estimated as 60 gpm (based on visual examination) throughout the test. Steven's Type F water level recorders monitored the continuous hydraulic response in test wells TW7, TW10, TW12, TW19 and TW34 (see Plate I for location of test wells). Water level measurements in TW3, TW4, TW8, TW9, TW11 and TW21 were also recorded during the test using an electric probe. Samples of the pumped water were collected on a regular basis and analyzed in the Monsanto laboratory for pH, temperature, specific conductance and fluoride.

3.5.4 Testing of Plant Production Wells

The purpose of plant production well testing was to measure formation hydraulic properties resulting from a large scale perturbation to the ground water flow system. Due to the continuous demand for water at the site, it was impossible to fully shut down the plant production wells. Testing was thus carried out by monitoring the hydrauilc response induced due to the intermittent pumping schedule.

Normal production well pumpage utilizes PW3 on a continuous basis and PW2 on an intermittant basis, with PW1 idle. On July 31st, 1984, water levels were measured in production wells PW1 and PW3 to monitor the effect of the intermittent pumping of PW2. However, water levels could not be recorded in PW2 due to the presence of oil in the well which caused the probe to malfunction; a layer of oil is typically found in wells where an oil lubricated turbine shaft pump is installed. At the time of monitoring, PW3 pumped continuously at a rate of about 2000 gpm, PW2 pumped about 680 gpm for a period of approximately 6 minutes followed by a 10 minute shutdown and PW1 was idle. A totalizing flow meter on PW2 measured the flow rate during each pumping period.

On November 30th, 1984, while PW2 was pumping intermittently, water level monitoring was conducted at test wells TW25, TW26 and TW27 to determine if a hydraulic response could be measured. Depth-to-water measurements were taken with an electric probe at one minute intervals for a period of 30 minutes at each test well.

On December 19th, 1984, the plant production well pumping sequence was changed for approximately 6 hours in an attempt to perturbate the aquifer in a unique, but controlled fashion. PW1 was pumped intermittently (instead of PW2) while PW3 pumped continuously. After 6 hours, the pumping schedule was switched back to the original schedule. PW1 pumped at an estimated pumping rate of 900 gpm on a regular cycle of approximately 4-1/2 minutes on followed by 13 minutes off during the 6 hour period. Steven's Type F recorders monitored water levels in test wells TW24, TW26 and TW30 before, during and after the test.

3.6 Water Quality Sampling

3.6.1 General

Water quality sampling was undertaken during the drilling and development of the new test wells to determine the following: whether different hydrogeochemical zones were present during drilling; stable geochemical conditions during test well development and to provide the basis for interpreting the sources of, fate and transport of specific ions within the local hydrogeological regime. These data/interpretations were considered preliminary and thus Quality Control/Quality Assurance (QC/QA) was limited.

Subsequently, two phases of overall water quality sampling were carried out on the completed test wells. A Quality Assurance/Quality Control program was undertaken in conjunction with the two phases of overall water quality sampling.

3.6.2 Sampling During the Drilling Program

Ground water samples were generally collected every 5 ft during the drilling program to recognize if different hydrochemical zones were present. The pH, conductivity, Eh and temperature of the ground water were measured at the drill site immediately after obtaining the sample. The field instrumentation used to analyze the sample were as follows:

YSI conductivity and temperature probe and SSI (Scientific Supply Inc.) combination pH and Eh meter. These data are presented on the field borehole logs in Volume 2. During December, January and February ground water quality measurements were made less frequently due to the extremely cold temperatures (-20 to +10°F). The extreme cold resulted in equipment malfunction and aberrant readings.

Selected ground water samples were also submitted to the Monsanto laboratory for fluoride analysis. The samples were collected in a sterilized and rinsed 500 ml plastic sample bottle and delivered to the laboratory within 2 to 3 hours of collection.

Table 3.5 indicates the boreholes that were sampled and the depth of the borehole at the time the water was sampled.

3.6.3 Sampling During Well Development

Water samples were collected on a regular basis during test well development to determine stable (not affected by the drilling process) geochemical conditions. For most test wells, the water temperature, conductivity, pH and Eh were measured immediately after obtaining the sample using the field equipment discussed in the previous section. Generally, four or five sets of measurements were taken during the course of development. The parameters measured at each test well are indicated on Table 3.5 and the data are included in Appendix 2.

Water samples collected towards the end of well development were submitted to the Monsanto laboratory for fluoride analysis. Water samples from test wells TW9 to TW18, inclusive, were also submitted to Northern Engineering and Testing's laboratory in Billings, Montana, for analysis of additional constituents.

TABLE 3.5

SUMMARY OF WATER QUALITY SAMPLING
DURING DRILLING/TEST WELL DEVELOPMENT

TEST WELL NUMBER	SAMPLE DATE	SAMPLE METHOD	WELL DEPTH (ft)	LABORATORY	PARAMETERS ANALYZED
TW9	08/21/84 08/23/84 09/24/84	Drill Return Drill Return Pump	88 210 253	Monsanto Monsanto N.E.T. GA Monsanto	F, pH F, pH FS T, C, pH, Eh F
TW10	09/20/84	Pump	27	N.E.T. GA Monsanto	FS T, C, pH, Eh F
TW11	08/30/84 09/17/84	Drill Return Air	87 137	Monsanto N.E.T. GA N.E.T.	F Dissolved Metals T, C, pH, Eh Dissolved Metals
TW12	09/17/84	Air	99	GA N.E.T.	T, C, pH, Eh Dissolved Metals
TW13	09/18/84 09/18/84 10/08/84	Drill Return Drill Return Air	22 45 96	Monsanto Monsanto GA Monsanto N.E.T.	F F T, C, pH, Eh F FS
TW14	10/08/84 10/27/84	Air Bailer	21 21	GA Monsanto N.E.T. GA N.E.T.	T, C, pH, Eh F FS T, C, pH Dissolved Metals
TW15	10/08/84 10/27/84	Air Bailer	59 59	GA Monsanto N.E.T. GA N.E.T.	T, C, pH, Eh F FS T, C, pH Dissolved Metals

TABLE 3.5 (Cont'd)

TEST WELL NUMBER	SAMPLE DATE	SAMPLE METHOD	WELL DEPTH (ft)	LABORATORY	PARAMETERS ANALYZED
TW16	09/29/84	Air	77	GA Monsanto N.E.T.	T, C, pH F FS
TW17	09/22/84 09/29/84	Drill Return Air	82 107	Monsanto N.E.T. GA Monsanto N.E.T.	F FS T, C, pH F FS
TW18	09/29/84	Air	238	GA Monsanto N.E.T.	T, C, pH F FS
TW19	10/01/84	Drill Return	29	Monsanto N.E.T.	F FS
TW20	10/18/84	Air	44	GA Monsanto	T, C, pH, Eh F
TW21	10/18/84	Air	123	GA Monsanto	T, C, pH F
TW22	10/09/84 11/02/84	Drill Return Air	89 112	Monsanto GA Monsanto	F T, C, pH F
TW23	10/12/84 10/13/84 11/02/84	Drill Return Drill Return Air	159 229 190	Monsanto Monsanto GA Monsanto	F F T, C, pH F
TW24	11/02/84	Air	92	GA Monsanto	T, C, pH F

TABLE 3.5 (Cont'd)

TEST WELL NUMBER	SAMPLE DATE	SAMPLE METHOD	WELL DEPTH (ft)	LABORATORY	PARAMETERS ANALYZED
TW25	10/19/84 10/20/84 10/22/84 11/05/84	Drill Return Drill Return Drill Return Air	97 137 248 191	Monsanto Monsanto Monsanto GA	F F F T, C, pH
TW26	11/05/84	Air	141	GA Monsanto	T, C, pH, Eh F
TW27	11/05/84	Air	95	GA Monsanto	T, C, pH, Eh F
TW28	11/01/84 11/07/84	Drill Return Air	50 89	Monsanto GA Monsanto	F T, C, pH, Eh F
TW29	11/07/84	Air	47	GA Monsanto	T, C, pH, Eh F
TW30	11/08/84	Drill Return	68	Monsanto	F
TW31	12/13/84	Air	31	GA Monsanto	T, C, pH, Eh F
TW32	12/12/84	Air	181	GA Monsanto	T, C, pH F
TW33	12/12/84	Air	75	GA Monsanto	T, C, pH F
TW34	12/11/84 12/13/84	Drill Return Air	41,46 47,68 74 74	Monsanto GA Monsanto	F T, C, pH F

TABLE 3.5 (Cont'd)

TEST WELL NUMBER	SAMPLE DATE	SAMPLE METHOD	WELL DEPTH (ft)	LABORATORY	PARAMETERS ANALYZED
TW35	01/29/85 01/30/85 02/14/85	Drill Return Drill Return Air	50,55 81,122 89	Monsanto Monsanto GA Monsanto	F F T, C, pH F
TW36	02/02/85 02/12/85	Drill Return Air	47,53 54	Monsanto GA Monsanto	F T, C, pH F
TW37	02/12/85	Air	100	GA Monsanto	T, C, pH F
TW38	02/06/85 02/12/85	Drill Return Air	102 102	Monsanto GA Monsanto	F T, C, pH F
TW39	02/08/85 02/14/85	Drill Return Air	55 56	Monsanto GA Monsanto	F T, C, pH F
TW40	02/17/85	Air	89	GA Monsanto	T, C, pH F

NOTES: GA = Golder Associates

N.E.T. = Northern Engineering and Testing

T = Temperature

C = Conductivity

F = Fluoride

FS = Full suite of analyses

Water samples from test wells TW9 and TW10 (developed with the available nearby submersible pump from TW7) were collected from the end of a discharge hose in a two gallon plastic pail and transferred into sterile, rinsed plastic sample bottles. These were non-aerated samples. Water samples from the other test wells (developed using compressed air to expedite the well development process) were collected as the water fell into a plastic pail hung at the well head. The sample was then transferred into sterile rinsed sample bottles. Laboratory preparation of the water samples is detailed in Section 3.6.5.

3.6.4 Primary Sampling Program

Ground water samples were obtained from all test wells, plant production wells, several offsite private wells, and springs, and the plant effluent discharge. The purpose of the sampling was to obtain representative ground water and surface water samples to determine the water quality upgradient, downgradient and within the Monsanto plant site boundaries. These data were used to assess the hydrogeochemical environment and the impact of past or present operations on the surface/ subsurface water quality.

Water quality sampling was carried out in two phases:

PHASE I - November 7th to 14th and December 14th to 18th, 1984. The November sampling encompassed test wells TW2 to TW30, inclusive; plant production wells PW1, PW2 and PW3; offsite wells SWC, SWG, Lewis and Nelson; springs Calf, Mormon, Dock, Hooper and Southwest; and the effluent stream. Test wells TW31 to TW34 were sampled in December, 1984.

PHASE II - February 18th to March 2nd, 1985, encompassing test wells TW2 to TW40, inclusive; plant production wells PW1, PW2 and PW3; offsite wells SWG and Lewis; springs Calf, Mormon, Dock, Hooper and Southwest; and the effluent stream. The SWC well was not available at the time of sampling. The Nelson well was not sampled since the well was considered to be too far removed from the study area.

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The methodology adopted for sampling was to ensure that the water samples collected represented the aquifer water and not the stagnant water above the screen or the effects of cross-contamination introduced by the drilling method. To achieve this goal, between 3 to 5 well volumes were evacuated from the test wells before sample collection. The effluent stream and springs were sampled by immersing a sample bottle in the flowing water.

Due to the differing conditions (i.e. well depth, height of stagnant water above well screen and presence/absence of a committed pump) in the sampled wells, three different methods of well evacuation were adopted as follows:

- o For those wells without a pump and with greater than 10 ft of stagnant water standing above the well screen, compressed air was used to evacuate 3 to 5 well volumes of water. The compressed air was introduced via a neoprene hose at least 10 ft above the top of the well screen to prevent aeration of the aquifer.
- o For those test wells without a pump and with less than 10 ft of stagnant water standing above the well screen, a teflon bailer was used to evacuate 3 to 5 well volumes.
- o For those wells with a committed pump (i.e. the plant production wells, TW2 and offsite wells), the pump was turned on for 5 to 20 minutes to evacuate the well.

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Following evacuation, those wells with committed pumps were sampled by placing the sample bottle under the discharge tap. Those wells without committed pumps were sampled in the well screen interval using a point source teflon bailer. As the bailer was run down through the well water column, both upper and lower check valves opened allowing water to flow through the bailer. When the bailer reached the desired sampling depth (well screen interval), the bailer was pulled from the well. Hoisting on the bailer closed both upper and lower check valves ensuring that the sample collected came from the well screen interval and was not mixed with aerated water from above the well screen. The teflon bailer was rinsed twice with distilled water inside and outside before use in each well. The lower part of the polypropylene cable attached to the bailer was also rinsed with distilled water before use in each well.

Two liters of water were collected from each sampling location. The sample was placed in a sterile, two litre plastic container rinsed with a small amount of the sample water before filling.

Field blanks were prepared at various sites throughout the plant to assess whether contamination was introduced during sampling. Contamination could be induced either by airborne particles or by using the teflon bailer for each of the wells. Four field blanks were prepared during both the Phase I and II sampling. The field blanks were prepared by first rinsing the bailer twice with distilled water (normal field procedure between the sampling of different wells). The bailer was then rinsed a third time with distilled water and this rinse water collected in the sample bottle for analysis. Field blanks were given the designation "A" following the sampling of a particular well. For example, sample TW17A is a field blank taken after sampling test well TW17.

A series of sample duplicates and laboratory spikes were submitted during the second phase of sampling as a check on the reliability of the laboratory analyses. Five test wells, TW17, TW19, TW29, TW31 and TW39, were selected for sample duplication and spiking. For these quality assurance samples, 6 liters of well water was collected in three 2 liter sample bottles for each well. The preparation of these samples is discussed in Section 3.6.5.

Table 3.6 indicates the sampling method for each well, the springs and the effluent stream, and the amount of water evacuated prior to sampling.

3.6.5 Laboratory Procedures

Water samples collected during well development were delivered to the Monsanto laboratory for fluoride analysis. The analyses were carried out on unfiltered samples within a day of arriving at the laboratory. These samples, although not preserved according to standard methods, provided preliminary information used to assess the hydrogeological environment and aid in additional drill site selection.

Water samples from test wells TW9 and TW10 were filtered through a 0.45 micron filter and preserved according to "Methods for Chemical Analysis of Water and Wastes" (U.S. Environmental Protection Agency, unpublished 1982) and then shipped to Northern Engineering and Testing's laboratory. These samples were field prepared (filtered and preserved) and analyzed as had been accomplished on nearby test wells TW7 and TW8 for comparison purposes. Water samples from test wells TW11 to TW18 were neither filtered nor preserved prior to shipping to the Northern Engineering laboratory. These samples, although not accurate due to the lack of field preparation, provided preliminary information used to assess the hydrogeological environment and aid in additional drill site selection. Results of these analyses are presented in Volume 3.

Water samples collected during the Phase I and Phase II sampling periods were brought to Monsanto's laboratory within 1 to 3 hours of collection. Water temperature, specific conductance, pH and Eh were immediately measured in the laboratory on the raw, unfiltered water. All water samples were then preserved and stored in accordance with Methods for Chemical Analysis of Water and Wastes (U.S. Environmental Protection Agency, unpublished 1982).

TABLE 3.6

WATER QUALITY SAMPLING DETAILS

Test Well Number	PHASE I Quantity of Water Evacuated/Number of Well Volumes (Gallons)	PHASE I (Volumes)	PHASE I Method of Evacuation	PHASE II Quantity of Water Evacuated/Number of Well Volumes (Gallons)	PHASE II (Volume)	PHASE II Method of Evacuation
TW2	-	-	Pump run 5 minutes	-	-	Pump run 5 minutes
TW3	600	3-3.5	Airhose set to 150'	500-600	3-3.5	Airhose set to 145'
TW4	240	3	Airhose set to 70'	240-250	3	Airhose set to 70'
TW5	300	3.5	Airhose set to 95'	300-325	3	Airhose set to 95'
TW6	150	3	Airhose set to 80'	150-170	3	Airhose set to 80'
TW7	110	4	Airhose set to 40'	85-100	3	Airhose set to 40'
TW8	90	2	Airhose set to 65'	135	3	Airhose set to 65'
TW9	450-500	3	Airhose set to 130'	650	4	Airhose set to 130'
TW10	31	4	Bailer	31	4	Bailer
TW11	300	6.5	Airhose set to 130'	150-170	3	Airhose set to 125'
TW12	120	5	Airhose set to 80'	70-80	3	Airhose set to 80'
TW13	200	4	Airhose set to 20'	200	4	Airhose set to 20'
TW14	25	3	Bailer	25	3	Bailer
TW15	100	3	Airhose set to 30'	100	3	Airhose set to 30'
TW16	35	3.5	Bailer	20	2	Bailer
TW17	100	3	Airhose set to 75'	100	3	Airhose set to 70'
TW18	300	3	Airhose set to 90'	300-310	3	Airhose set to 90'
TW19	18	3.5	Bailer	26	5	Bailer
TW20	25	3	Bailer	26	3	Bailer
TW21	300	4.5	Airhose set to 93'	200	3	Airhose set to 93'
TW22	120	4	Airhose set to 85'	120-140	4	Airhose set to 85'
TW23	350	4	Airhose set to 90'	350-400	4	Airhose set to 90'
TW24	70	4	Airhose set to 80'	70-80	4	Airhose set to 80'
TW25	115	2	Airhose set to 170'	110-120	2	Airhose set to 150'
TW26	120-130	4	Airhose set to 115'	100	3	Airhose set to 115'
TW27	16	3	Bailer	13-14	3	Bailer
TW28	160-170	5-5.5	Airhose set to 65'	100-110	3	Airhose set to 65'
TW29	25	3	Bailer	25	3	Bailer
TW30	21	3	Bailer	22	3	Bailer
TW31	20	3	Bailer	20	3	Bailer
TW32	325-375	3-3.5	Airhose set to 90'	300	3	Airhose set to 140'
TW33	100	3	Airhose set to 40'	100	3	Airhose set to 55'
TW34	100	3	Airhose set to 60'	100	3	Airhose set to 60'
TW35	- - - - - - - NOT DRILLED - - - - - - -			120	3	Airhose set to 45'
TW36	- - - - - - - NOT DRILLED - - - - - - -			60	3	Airhose set to 40'
TW37	- - - - - - - NOT DRILLED - - - - - - -			70-90	3	Airhose set to 80'
TW38	- - - - - - - NOT DRILLED - - - - - - -			36	3	Bailer
TW39	- - - - - - - NOT DRILLED - - - - - - -			60-70	3	Airhose set to 35'
TW40	- - - - - - - NOT DRILLED - - - - - - -			14	3	Bailer
PW1	-	-	Tap run 5 minutes	-	-	Tap run 20 minutes
PW2	-	-	Tap run 5 minutes	-	-	Tap run 5 minutes
PW3	-	-	Tap run 5 minutes	-	-	Tap run 5 minutes
SWG	-	-	Tap run 5 minutes	-	-	Tap run 5 minutes
SWC	-	-	Tap run 5 minutes	NOT SAMPLED		
Lewis	-	-	Tap run 5 minutes	-	-	Tap run 5 minutes
Nelson	-	-	Tap run 5 minutes	NOT SAMPLED		

The water samples were vacuum filtered through a 0.45 micron (μ) membrane. In some instances, where the well water was turbid, the sample was pre-filtered through a coarser (Number 4) filter before filtering through a 0.45 μ filter. Three aliquots were prepared from each water sample. The sample bottles were rinsed with a small amount of the sample before each bottle was filled. The three aliquots were:

- o one 500 ml filtered sample with no preservatives for basic water analysis ("raw" sample)
- o one 500 ml filtered sample with 5 ml 1:1 nitric acid for dissolved metals analysis ("metals" sample) and
- o one 250 ml filtered sample with 5 ml 1:1 sulphuric acid for nutrients and ammonia analysis ("nutrients" sample).

During both sampling phases, two "reagent blank" quality assurance samples were prepared. These samples were submitted to determine if the acids and distilled water used in sample preparation and glassware cleaning in the Monsanto laboratory introduced contamination to the sample. These samples were designated Lab QA-1 and Lab QA-2 during both sampling phases. Lab QA-1 consisted of three aliquots of unfiltered distilled water prepared as above. Lab QA-2 consisted of three aliquots of unfiltered distilled water without preservatives.

During the Phase II sampling, five quality assurance well water samples were collected to assess the analysis quality of Northern Engineerings' laboratory. For each quality assurance sample, a 6 liter sample was first filtered through a 0.45 μ filter and then thoroughly mixed together in a large glass beaker. Three split samples were then prepared from the mixed sample:

(1) a <u>standard</u> sample was prepared and given the "true" well number designation. Three aliquots were submitted ("raw", "metals" and "nutrients") with appropriate preservatives for analysis;

(2) a duplicate of sample (1) was submitted under a non-existant well number unknown to the laboratory. The sample was prepared in an identical manner as the standard. Duplicate samples were numbered as follows:

Sample Well Number	Duplicate Analysis Number
TW17	TW47
TW19	TW45
TW29	TW43
TW31	TW41
TW39	TW49

(3) a spike sample was prepared by adding a known amount of US EPA certified spike of a particular group of substances to 900 ml of the sample. The sample was then made up to 1000 ml with the following fluoride and nitrate spike concentrations and given a non-existant well number unknown to the laboratory:

Test Well Number	Spike Analysis Number	Fluoride (mg/l)	Nitrate-Nitrogen (mg/l)
TW19	TW46	0.23	0.08
TW31	TW42	1.36	1.67
TW37	TW50	2.28	9.10

Samples from test wells TW17 and TW29 were made up to 1000 ml with the following trace metal spike concentrations:

Test Well No.	Spike Analysis Number	Concentration in mg/l							
		As	Ba	Cd	Cr	Pb	Hg	Se	Ag
TW17	TW48	0.086	0.688	0.0092	0.092	0.090	0.0028	0.0152	0.068
TW29	TW44	0.027	0.192	0.0033	0.018	0.028	0.0018	0.006	0.028

Chain of custody procedures were initiated in the Monsanto laboratory with all sampling data documented in a record book for future reference. The data are presented in the data volume. Following sample preparation, the bottles were stored in a cooler at about 4°C before being shipped to Northern Engineering and Testing in Billings, Montana for analysis.

3.7 Water Level Monitoring

A water level monitoring program was initiated during the preliminary pump testing program in August 1984. The monitoring program continued throughout the drilling and completion of new test wells, expanding to include a total of 39 test wells by March, 1985. The purpose of the monitoring program was:

- to monitor and assess long term (seasonal) and short term (precipitation, barometric and earthtide induced) ground water level fluctuations beneath the site;
- to provide hydraulic head data throughout the site to assess lateral and vertical ground water flow components and hydraulic gradients;
- to monitor hydraulic responses due to the drilling and/or development of new test wells and the pumping of plant production wells; and
- to provide input to the conceptual ground water flow model for the site.

Water level monitoring was carried out from August, 1984, through February, 1985, except for the period between December 20th, 1984 and January 28th, 1985 when no data were recorded. Water levels were measured and recorded at least once a week (usually 2 to 3 times a week) throughout the project. The length of record of each test well depends on its date of completion. Nearly 8 months of records are available for existing test wells TW2 to TW8, while only 0.5 to 2 months of data are available for TW30 to TW40 completed towards the end of the study.

Water level measurements were made using a combination of Stevens Type F recorders and hand measurements with electric water level probes.

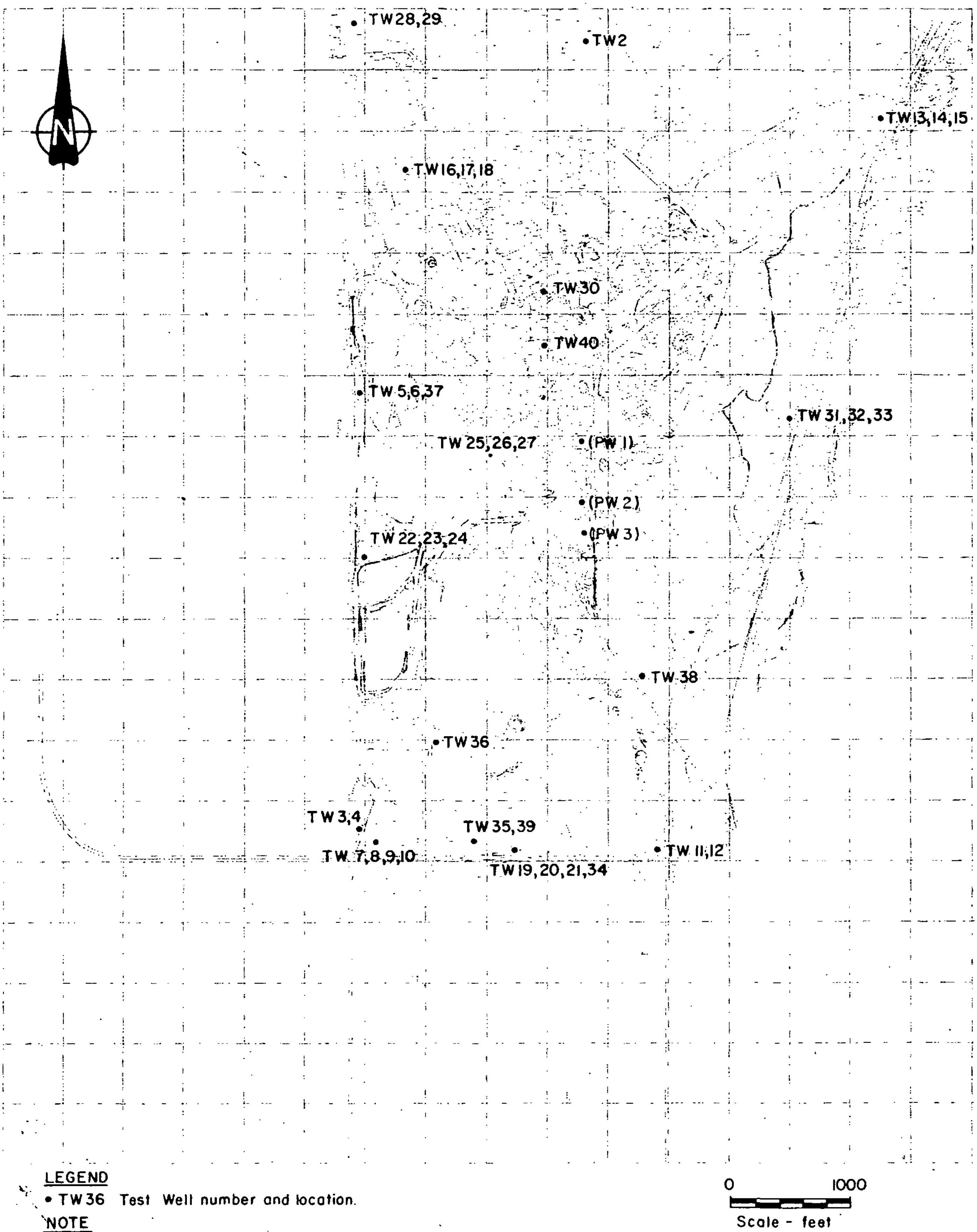
Stevens Type F water level recorders, with attached floats or Johnson-Keck sensing devices, were used to provide a continuous record of water levels in selected wells during the program. Usually, once a new monitor well was completed, the well was instrumented with a Stevens recorder to assess background water level fluctuations. Following instrumentation for 1 to 2 weeks, the recorder was removed and discrete water level measurements taken 2 to 3 times a week using an electric probe. A full description of the type of water level instrumentation used in each well during the program is given in the data volume.

TABLE 3.1

SUMMARY OF NEW TEST WELL DRILLING AND COMPLETION

TEST WELL NUMBER	DATE DRILLING STARTED	DEPTH DRILLED BELOW GROUND SURFACE (ft)	DATE COMPLETED	COMPLETION INTERVAL BELOW GROUND SURFACE (ft)
TW9	08/17/84	253	08/24/84	236 to 253
TW10	08/27/84	27	08/28/84	18 to 27
TW11	08/28/84	142	09/13/84	127 to 137
TW12	08/31/84	102	09/14/84	84 to 99
TW13	09/17/84	98	09/19/84	79 to 96
TW14	09/19/84	24	09/19/84	13 to 21
TW15	09/20/84	60	09/20/84	48 to 59
TW16	09/21/84	82	09/25/84	68 to 77
TW17	09/21/84	115	09/24/84	96 to 107
TW18	09/25/84	250	09/29/84	219 to 238
TW19	10/01/84	29	10/01/84	23 to 29
TW20	10/01/84	48	10/02/84	35 to 44
TW21	10/02/84	130	10/08/84	105 to 123
TW22	10/08/84	112	10/16/84	104 to 112
TW23	10/09/84	231	10/11/84	171 to 190
TW24	10/16/84	92	10/18/84	73 to 92
TW25	10/18/84	250	11/03/84	179 to 191
TW26	10/24/84	142	10/27/84	135 to 141
TW27	10/29/84	98	10/30/84	88 to 95
TW28	11/01/84	89	11/06/84	76 to 89
TW29	11/02/84	47	11/02/84	39 to 47
TW30	11/08/84	69	11/08/84	62 to 69
TW31	12/03/84	42	12/03/84	22 to 31
TW32	12/04/84	190	12/13/84	151 to 181
TW33	12/05/84	75	12/10/84	67 to 75
TW34	12/10/84	74	12/13/84	67 to 74
TW35	01/28/85	128	02/13/85	71 to 89
TW36	02/01/85	54	02/02/85	48 to 54
TW37	02/04/85	102	02/13/85	93 to 100
TW38	02/05/85	102	02/07/85	90 to 102
TW39	02/07/85	57	02/13/85	48 to 56
TW40	02/17/85	89	02/17/85	82 to 89

TEST WELL LOCATION MAP	Figure 3.1



LEGEND

• TW36 Test Well number and location.

NOTE

Test Wells TW 3,4,5,6,7,8 are existing wells completed prior to present investigation. PW1, PW2, PW3 are Plant Production Wells.

inclusive. Where ground water was produced during the drilling, water temperature, pH, conductivity and Eh were measured at 5 ft intervals. "History of hole" forms documenting the drilling and completion of each borehole were prepared. These are presented in Volume 2.

It was anticipated that some drilling difficulties (loss of circulation and/or borehole instability) could be encountered while drilling open hole in a layered basalt environment using air/water as the circulating fluid. Such difficulties were encountered early in the drilling program and are briefly described below for test wells TW9 and TW11.

Test well TW9 was the first borehole drilled during the present investigation. After setting of nominal 8 inch surface casing through the overburden, an unconsolidated, caving, water-bearing cinder zone was encountered between 24 to 27 ft below ground surface. The borehole could not be maintained open beyond this depth. To stabilize the borehole and continue drilling past this zone, the 8 inch casing was pulled from the borehole and the borehole reamed at nominal 10 inch diameter to 31 ft, and 8 inch casing set to 31 ft. The borehole was then drilled at nominal 8 inch diameter to 253 ft below ground level without encountering further difficulties.

Test well TW11 was initially drilled at nominal 8 inch diameter. An unconsolidated, water-bearing, caving, cinder zone was found between 89 and 100 ft, where the return of rock cuttings and water were lost. An attempt was made to grout the cinder zone by pumping a grout/bentonite mixture with an accelerator (calcium chloride) into the zone. However, the grout was "lost" into the cinder zone before setting. A second attempt was made to seal the cinder zone using a thicker sand/ cement grout with a similar lack of success. Subsequently, in order to advance the borehole through the cinder zone and to ensure the return of cuttings and water to the surface, the borehole was reamed and completed using the telescoping technique.

The subsequent drilling program was altered as a result of the aforementioned difficulties. Subsequent boreholes were drilled at 8 inch diameter to their required depth (if possible), or as deep as possible before circulation of cuttings and water were lost. A well was then completed at the depth where circulation was lost. In some instances, lost circulation problems or caving conditions resulted in the first borehole of a well nest being drilled to less than the intended 250 ft depth. Subsequent boreholes at such a location were drilled using the telescoping technique. This involved drilling at nominal 10 inch diameter to the bottom of the caving/lost circulation zone and setting nominal 8 inch diameter casing through the problem zone. The boreholes were then continued at nominal 8 inch diameter to their required depths.

3.3.3 Test Well Completion

All boreholes were completed with flush joint threaded Schedule 40 nominal 4 inch diameter PVC pipe and well screen. Well screens were machine slotted with 0.02 inch (20 slot openings). The base of the well screen was fitted with a threaded cap. All joints were sealed with teflon tape for a water-tight seal. Centralizers were attached to the PVC pipe every 30 to 40 ft so that the pipe was centered in the borehole. The well screen was usually set at the bottom of the borehole. In some instances where no water-bearing zone was present within 10 to 20 ft of the bottom of the hole, the lower part of the hole was sealed using a grout/bentonite/flocele (a lost circulation material consisting of plastic chips) mixture, pumped via tremie pipe to within a few feet of the intended completion zone.

After the PVC screen and riser were set, the well screen was gravel packed to between 2 to 3 ft above the top of the screen. A bentonite pellet seal, at least 3 ft thick, was then placed above the gravel pack.

The borehole annulus was then sealed back to ground level using a grout/bentonite/flocele mixture pumped into the annulus using a tremie pipe. Where the annulus did not fill up to ground level with grout, the annulus was topped off with a sand/grout mixture added from the surface, provided no water was present in the borehole. Where standing water was present in the hole, the hole was grouted to surface using a grout/bentonite/flocele mixture by means of a tremie pipe. All additions of material (bentonite pellets, gravel, grout) were sounded and recorded in field notebooks during well completion.

Where possible, the 8 inch surface casing used to stabilize the borehole during drilling was withdrawn from the borehole during well completion. Where the 8 inch surface casing could not be pulled from the borehole (test wells TW11, TW12, TW25 and TW26), the casing was either perforated or cut to allow the grout to fill the annulus between the steel casing and the borehole wall.

The PVC riser was cutoff between 2 to 3 ft above ground level and a loose slip PVC cap installed. Protective 6 inch diameter steel casings with the well number welded to the casing were set over the PVC risers and cemented into place to secure the monitoring wells. The top of the PVC was later surveyed in and an indelible mark left on the casing as a datum for water level measurements.

The test wells were developed using either compressed air, a bailer or a submersible pump. Development was carried out until the discharge was clear and water temperature, conductivity, pH and Eh values stabilized. Water samples were collected at the end of development and analyzed for fluoride (chosen as a tracer to aid in selecting the locations of subsequent test wells) in the Monsanto laboratory (Section 3.6.3). Selected samples were also sent to Northern Engineering and Testing in Billings, Montana, for detailed analyses. These analyses are presented in Volume 3. Water levels in the test wells adjacent to the test well being developed were monitored during air-lifting or pumping to evaluate well completion hydraulics and where possible aquifer hydraulics.

3.4 Borehole Geophysical Logging

3.4.1 General

Borehole geophysical logging was carried out in the existing test wells and in all of the new test wells completed during the present study (Table 3.2). The purpose of the geophysical logging was to substantiate lithologic interpretations, to aid in stratigraphic correlation and to identify possible aquifer zones.

A brief description of the various borehole geophysical logs run during the study is given in Table 3.3. Studies of borehole geophysical logging in basaltic environments (Crosby and Anderson, 1971) indicate that the natural gamma log is the most useful log for determining lithostratigraphic correlation. Clayey interflow zones show high natural gamma activity, whereas dense basalts are normally very low in radioactivity. Electric logs (single point resistivity and spontaneous potential) do not have a "characteristic response" in basaltic environments.

Gamma-gamma and neutron-neutron logs, when corrected for borehole conditions, provide information on the relative density, and porosity or moisture content, respectively, of rocks in a basaltic environment. A fluid temperature log is useful in indicating zones of water influx to, or efflux from, a borehole.

3.4.2 Existing Test Wells

Test wells (TW2 to TW8) were logged by Washington State University (WSU) between August 3rd and 4th, 1984. Logging was carried out under the supervision of Golder Associates personnel. After the submersible pumps had been pulled from the wells, each well was logged using natural gamma, gamma-gamma and neutron-neutron tools. In addition, TW3 and TW6 were logged using a temperature tool.

4.0 RESULTS OF FIELD PROGRAM

4.1 Introduction

The field program provided a vast amount of new data to define better the hydrogeology of the plant site. The raw data are available in the daily field notes and reports found in the data volume and, where appropriate, in summary tables found in Volume 2 and in the appendices of this volume. The evaluation of these data for each subtask/investigation is presented in this section of the report. Section 5.0 combines the evaluations presented in this section to define the hydrogeological environment beneath the Soda Springs plant site.

4.2 Geology

4.2.1 Surface Reconnaissance

4.2.1.1 Stratigraphy

Most of the surface exposures of basalt in the vicinity of the plant site are mantled with loose debris and basalt boulders. As such, representative in-place and intact outcrops of basalt are scarce. However, several outcrops of intact basalt were examined in the Blackfoot Lava Field further north in T6S, R42E and T8S, R41E. Generally, these basalts are fine grained and vesicular with well developed joints. Vertical joints are typically spaced 3 to 3.5 ft apart, with 1/2 to 1 inch wide apertures. Horizontal joints are commonly spaced 9 to 12 inches apart, with apertures of 1/2 to 1 inch wide, and are continuous for hundreds of feet. Photographs of typical basalt exposures are included in Volume 2.

Two exposures of the Salt Lake Formation were examined during the field reconnaissance in the area south and west of Bear River in the vicinity of Eightmile Creek. The first outcrop of Salt Lake Formation

TABLE 4.2

TEST WELLS

WELL HEAD AND SCREENED INTERVAL ELEVATIONS

Test Well Number	Elevation Top of PVC (ft)	Elevation Top of Protective Casing (ft)	Ground Elevation (ft)	Screened Interval (ft)
TW2	5989.97	**	5989*	5915 - 5729
TW3	5881.76	**	5880.26	5700 - 5630
TW4	5881.89	**	5880.07	5774 - 5754
TW5	5958.67	**	5956.97	5757 - 5736
TW6	5958.90	**	5957.10	5851 - 5831
TW7	5886.37	**	5884.46	5850 - 5824
TW8	5885.72	**	5884.67	5809 - 5789
TW9	5885.60	5885.90	5883.85	5648 - 5631
TW10	5886.44	5886.69	5884.44	5866 - 5857
TW11	5938.82	5938.97	5936.62	5808 - 5800
TW12	5940.13	5940.33	5937.63	5853 - 5837
TW13	5989.03	5989.28	5986.43	5907 - 5888
TW14	5989.16	5989.36	5986.46	5973 - 5962
TW15	5989.13	5989.33	5986.48	5938 - 5926
TW16	5999.30	5999.55	5996.85	5928 - 5920
TW17	5999.22	5999.47	5996.42	5901 - 5881
TW18	5997.77	5997.97	5994.62	5775 - 5756
TW19	5894.05	5894.20	5891.20	5868 - 5862
TW20	5894.26	5894.46	5891.76	5856 - 5847
TW21	5894.41	5894.61	5891.46	5786 - 5768
TW22	5955.64	5955.89	5952.44	5848 - 5840
TW23	5955.41	5955.55	5952.35	5781 - 5762
TW24	5955.39	5955.59	5952.49	5879 - 5860
TW25	5999.00	**	5995.80	5816 - 5804
TW26	5998.08	**	5995.58	5860 - 5853
TW27	5998.10	**	5995.50	5908 - 5902
TW28	5990.31	5990.61	5986.96	5911 - 5898
TW29	5990.30	5990.60	5987.70	5948 - 5940
TW30	5993.38	5993.58	5990.98	5929 - 5922
TW31	5976.23	5976.48	5973.88	5952 - 5944
TW32	5976.59	5976.84	5974.09	5823 - 5796
TW33	5976.53	5976.78	5974.03	5907 - 5899
TW34	5894.12	5894.47	5891.62	5824 - 5817
TW35	5898.08	5898.30	5895.03	5824 - 5806
TW36	5907.66	5907.89	5904.66	5856 - 5850
TW37	5960.10	5960.23	5957.10	5870 - 5857
TW38	5973.89	5974.03	5970.94	5882 - 5869
TW39	5897.99	5898.22	5894.99	5847 - 5839
TW40	5990.87	5991.00	5988.32	5906 - 5899

*Estimated

**No Protective Casing

located in Sec. 4, T10S, R42E is characterized as a fairly well indurated, interbedded conglomeratic sandstone. The gravel typically consists of well-rounded to sub-rounded clasts ranging from 1/4 to 6 inches in diameter (predominantely 1/2 to 3/4 inches). Clasts are composed primarily of quartzite and crystalline volcanic fragments. The conglomerate is supported with a silty fine sand matrix. The exposure exhibits fairly horizontal crude bedding (beds 2 to 5 ft thick). Locally, there are thin silty fine sand beds (average 1/4 inch thick). A second exposure of the Salt Lake Formation in Sec. 3, T10S, R42E appears to be a well indurated, water lain tuff consisting of medium to fine sand size ash particles. This exposure displays well developed thin beds between 1/4 to 1/2 inch thick. Photographs of these exposures are included in Volume 2.

4.2.1.2 Structure

As discussed in Section 2.0, a pronounced southwest facing topographic scarp enters the site near the northwest corner and exits the site (not as pronounced) just west of the southeast corner (see Figure 2.1). The scarp strikes approximately N29°W and decreases in height from 40 ft in the northwest plant site area to about 20 ft at the south end with a slope angle of between 15 to 17 degrees. Most of the scarp within the central portion of the property is obscured by slag piles and fill. Data assembled during the literature survey and geological reconnaissance indicates this scarp to be the surface expression of a normal fault crossing the plant site. However, no field evidence (i.e. slickensides or clay gouge) of faulting was observed.

4.2.2 Aerial Reconnaissance

The aerial reconnaissance flight and a review of aerial photography of the plant site vicinity shows the fault scarp passing through the site to be a component of a fairly narrow width (2.5 to 3 mile) of north trending, en-echelon normal fault scarps extending northward towards the west side of the Blackfoot Reservoir. These normal fault scarps exhibit both west and east side down relative displacement, commonly forming narrow grabens 1000 to 1500 ft wide and up to 2.5 to 3 miles long. Several of the grabens contain ponded water.

The fault scarp passing through the site extends south of the plant site where it becomes obscured by urban development. To the northwest of the plant site, the feature was traced continuously as far north as the western edge of Fivemile Meadow. Aerial photographs and reconnaissance suggests that this feature may continue for an additional 2.5 miles to the north where it appears to die out on the west flank of a basalt cone in Sec. 35, T7S, R41E.

Examination of the aerial photographs indicates a photo lineament parallel to and approximately 1500 ft west of the fault scarp. This photo lineament appears to enter the plant site just south of the coke and quartzite pond. Within the plant site the lineament is lost beneath the waste water ponds. The lineament is not visible south of the plant site. This photo lineament possibly represents the topographic expression of a subsidiary fault.

4.3 Drilling and Test Well Completions

4.3.1 Drill Cutting Analysis

Drilling proved the overburden materials to consist principally of silty clay up to 20 ft thick. In places within the plant site, this silty clay is mantled by a veneer of gravel fill or slag. The greatest thickness of fill (24 to 27 ft) was identified in the barrel storage area (TW25, TW26 and TW27). In the northeast plant site area, TW13 encountered 42 ft of overburden soils varying in composition from silty clay to sandy gravel. Sands and gravels within the overburden soils were also observed in TW31 along the eastern margins of the plant site.

Drill cuttings indicate that most of the basalt sequence is vesicular. These vesicles are occasionally infilled with zeolites. Although the basalt is generally fresh, showing little evidence of weathering, some thin (less than 15 ft thick), red stained, weathered basaltic zones are present within the sequence. In some of these zones, the basalt is nearly completely weathered, with only fragments of basalt remaining in a silty sand and gravel sized matrix.

The basalt is interbedded with scoriaceous cinders, silty clay, clayey silt or sands and gravels. These sedimentary interbeds vary in thickness from 23 ft (TW34) to less than 1 ft. The cinder zones are composed of unconsolidated subangular gravel to cobble size particles, ranging in diameter from less than 1/2 inch to greater than 6 inches. The particles are red/brown to grey and contain numerous vesicles (see Volume 2, Geological Photographs). The vesicles are occasionally infilled with zeolites. Clays and silty clays are occasionally present in the cinder zones, but are more usually found as discrete strata. The clays are generally red/ brown and sometimes grey.

The sands and gravels seen in TW11 are principally composed of subrounded limestone, basalt and sandstone fragments. The deposit appears to represent an infilled alluvial channel within the basalt.

The present drilling program encountered material of the Salt Lake Formation only in TW13 due to the local thinning of the basalts as they lap onto Threemile Knoll. The material is a light brown, fairly well indurated silty conglomerate.

4.3.2 Ground Water Production

In the course of the drilling program, ground water was encountered in the overburden soils, in the interbedded basalt sequence and in the Salt Lake Formation. Air lifted water flows ranged from less than a few gallons per minute, where limited saturated thickness was penetrated, to in excess of 200 to 300 gpm from some cinder zones.

The overburden soils were predominantly dry, with the exception of those in the northeast plant site corner (TW13, TW14 and TW15) and immediately south of the hydroclarifier (TW40). Test well TW14 is screened in a sandy gravel aquifer between 11 and 21 ft below ground level. During drilling, air lifted flows from this aquifer ranged between 5 and 10 gpm. Test well TW40 encountered damp silty clay at a depth of 22 ft below ground level, just above the basalt contact. However, the static water level in test well TW40 is about 82 ft below ground level.

Within the basalt sequence, the most prolific water producing zones were the cinder or weathered zones no more than 50 ft below the water table (with the exception of TW11). Air lifted flows were greatest (200 to 300 gpm), during the drilling of test wells TW20, TW21, TW34, TW35 and TW39 in a very permeable cinder zone, ranging in thickness from 5 to 23 ft. This cinder zone appears to thin westward and northward away from TW34, where the maximum thickness was recorded (Plate 2).

Test well TW11 encountered a sandy gravel aquifer at a depth of 132 ft below ground level within the basalt sequence. The full thickness of the aquifer was not determined. The deposit is believed to represent an alluvial channel fill deposit between basalt flows. Airlifted flows from this aquifer ranged from 50 to 70 gpm.

At depths greater than 100 ft below the water table, only minor increases in air lifted water flows were recorded. Once a significant amount of ground water had been intercepted by the borehole from a shallow depth, it was difficult to determine if ground water flows increased as drilling proceeded.

The silty conglomerate, believed to represent the Salt Lake Formation, encountered in TW13 did not yield significant ground water flows.

4.3.3 Test Well Completions

Thirty-one new test wells were installed during this investigation. A construction diagram and a generalized lithology for each new test well is presented in Appendix A. Further details concerning construction and detailed lithological logs are presented in Volume 2.

Difficulties experienced during completion of some of the new test wells are summarized in Table 4.1.

The results of the elevation survey and a calculated well screen interval for all the test wells are presented in Table 4.2.

4.4 Borehole Geophysical Logging

4.4.1 Washington State University Interpretation

Analog copies of the WSU borehole geophysical logs are found in the separate data volume. Evaluation and correlation of these data by Dr. E. Poeter is also presented in the data volume.

The radiation logs (gamma-gamma and neutron-neutron), which were run for the most in the completed test wells, were not considered useful for quantitative evaluation and only marginally useful for qualitative evaluation of the borehole lithology. These radiation logs are affected

TABLE 4.1

TEST WELL CONSTRUCTION PROBLEMS

TEST WELL NUMBER	CONSTRUCTION PROBLEMS	APPARENT ANOMALIES Nov/84 Sampling	APPARENT ANOMALIES Feb/Mar,85 Sampling
TW13	After gravel packing the well screen and placing the bentonite seal, the borehole caved to about 12 ft above the top of the bentonite seal. The remaining open hole was grouted back to the surface from this depth.	None	None
TW22	During grouting, 600 gals of grout (3 times the estimated borehole volume) was required to seal the borehole annulus.	TW22 - None TW24 - high pH (10.5) - low Eh (-7 mV)	TW22 - None TW24 - pH 11.2 - Eh -76 mV
TW25	After gravel packing the well screen, 150 lbs of bentonite pellets were added to the borehole annulus (sufficient to make a seal approximately 7 ft thick). Soundings indicated the seal was only 3 ft thick. The borehole was then grouted back to the surface from this depth.	TW25 - pH 9.40 - Eh -1 mV	TW25 - pH 9.9
TW32	During open hole geophysical logging, the borehole caved from total depth (190 ft) to 166 ft. The well screen was set to 166 ft and gravel packed with 1 cu.yd of gravel (approximately 7 times the volume estimated to fill the borehole annulus between 2 to 3 ft above the top of the screen). 150 lb of bentonite pellets (sufficient to make a seal 7 ft thick in the borehole annulus) were added. Soundings indicated the seal to be 1 ft thick (151 to 150 ft). The following day, the borehole was found blocked at a depth of 60 ft. The blockage, consisting of bentonite pellets, could only be partially removed. Seven hundred gallons of grout (four times the amount of grout required to fill the remaining borehole annulus to the surface) was pumped into the borehole from a depth of 60 ft. Soundings indicated the level of grout was below 60 ft. In order to complete the test well, the borehole annulus was filled up to a depth of 50 ft below ground surface with 1-1/2 yds of gravel. This is equivalent to 1.5 times the borehole annulus between 50 and 150 ft. The borehole annulus was then grouted to the surface without further difficulty.	TW32 - pH 11.0 - Eh -85 mV - Mg -1 mg/1	TW32 - pH 8.7

by borehole rugosity and should be side-collimated or corrected for changes in borehole size. However, caliper logs were only available for TW28 and TW32.

The generalized borehole lithology and cross-hole correlations made by Dr. Poeter, using primarily the natural gamma log, were an "eye-ball" fit of similar curve shapes and spikes. Dr. Poeter's evaluations/correlations did not consider other available data.

4.4.2 Golder Associates Interpretation

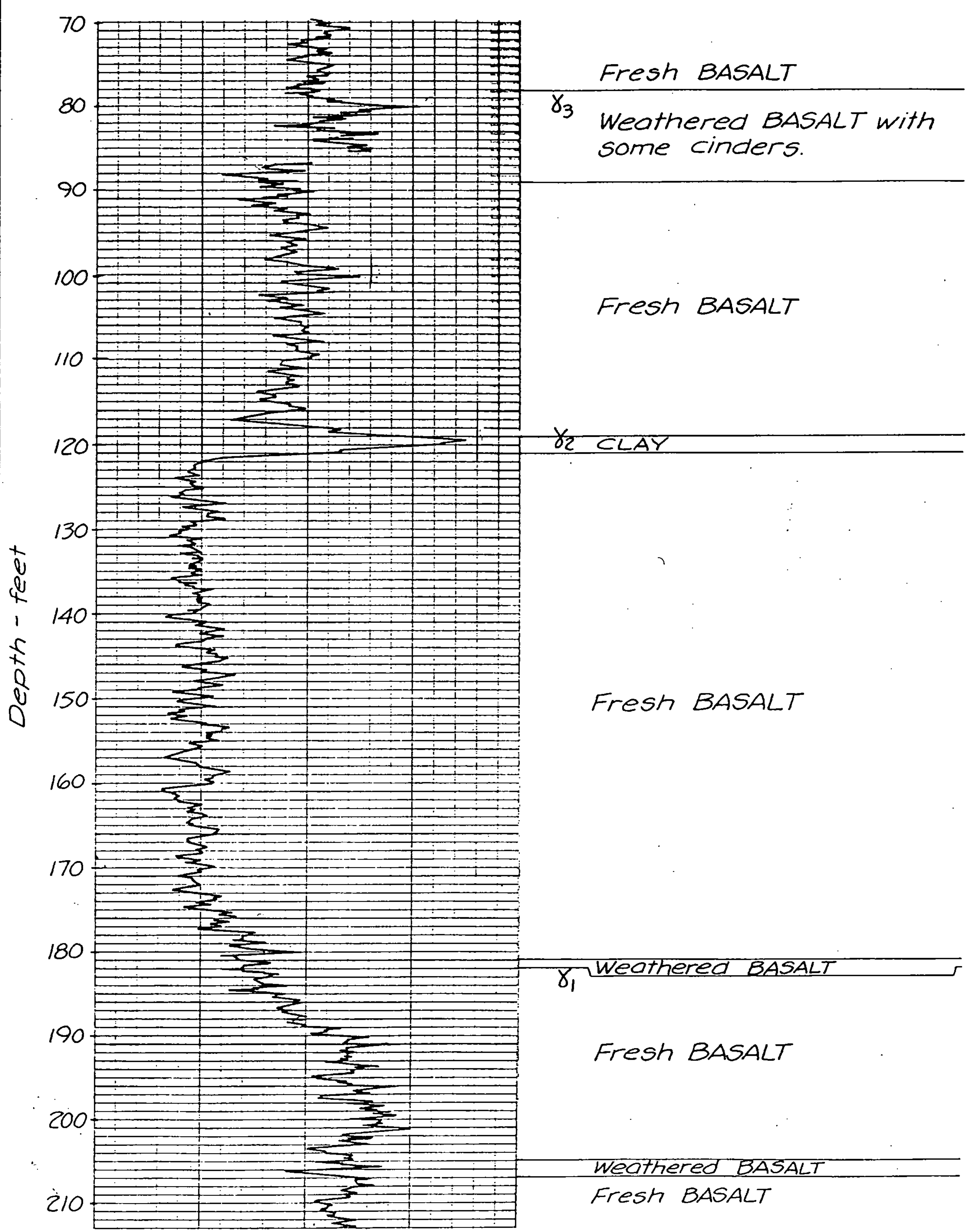
The Golder Associates evaluation/correlation was also primarily limited to the use of the natural gamma log for the reason described in Section 4.4.1. Golder Associates' fit was also an "eye-ball" of similar shapes and curves; however, Golder Associates' interpretation also made use of the drill penetration rate, the detailed drill-cutting descriptions, water bearing zones and ground water chemistry. The resulting evaluation/correlation presented below differs from that presented by Dr. Poeter. It is felt that the Golder Associates interpretation presented below is more representative, due to the use of all available data.

Stratigraphic correlations across the plant site have been made based on drill cuttings and on the natural gamma log signatures obtained from Golder Associates' open hole geophysical logs. Logging shows a number of characteristic horizons that can be traced over much of the southern and western plant site area. These horizons have been designated $\gamma 4$, $\gamma 3$, $\gamma 2$ and $\gamma 1$ (in order of increasing depth). The distinctive signature of each horizon is given below, and shown on Figures 4.1 and 4.2 where geophysical logs from test wells TW9 and TW21 are presented.

$\gamma 4$ – is a break to the right on the natural gamma log from a zone of relatively low activity to a zone of increasing activity. Lithologically, this zone varies between weathered basalt, silty sand and gravel to cinders.

TYPICAL NATURAL GAMMA LOG -TW9

Figure 4.1



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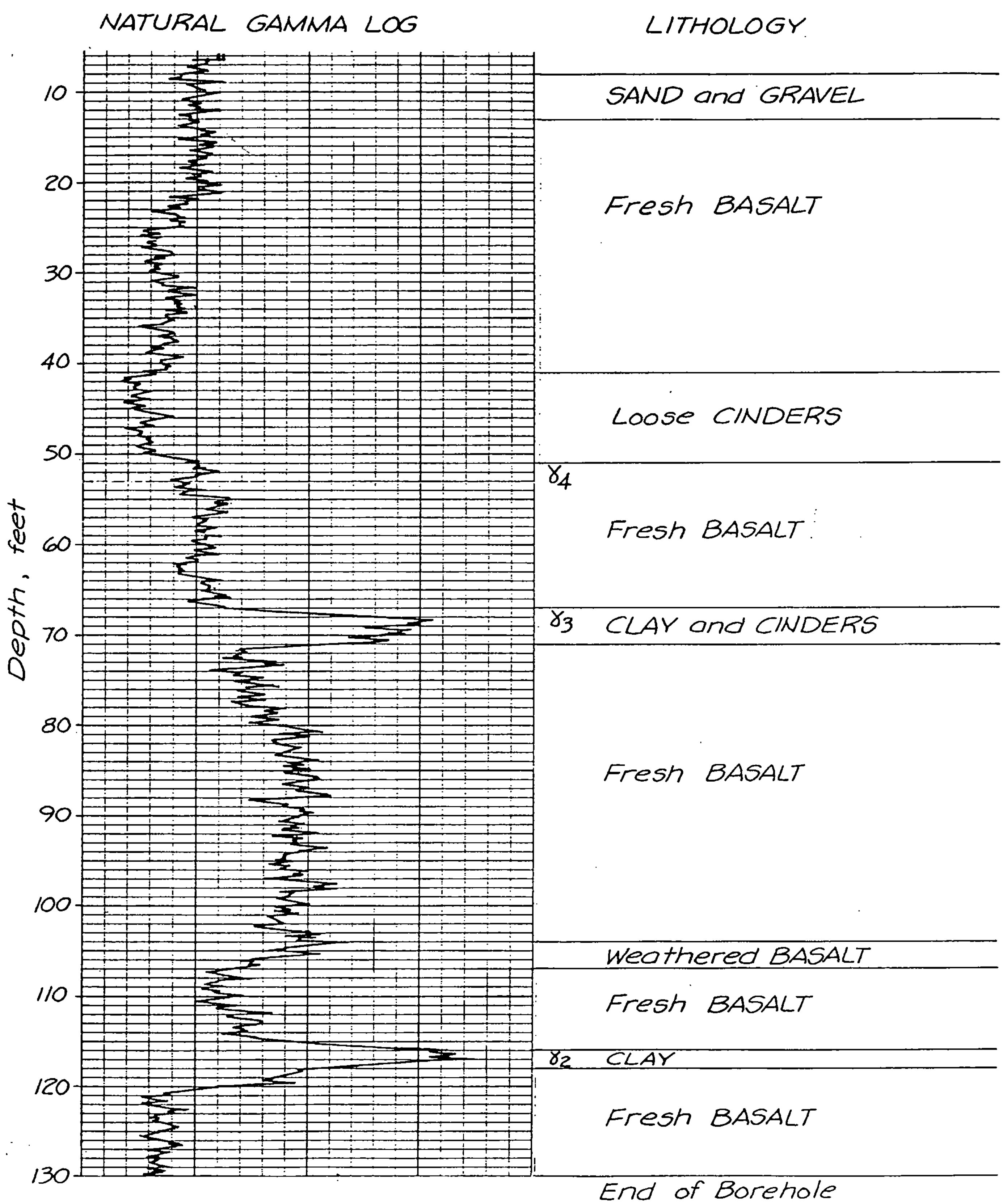
TYPICAL NATURAL GAMMA LOG - TW21

Figure **4.2**



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γ 3 - is a fairly thin zone of moderate to high natural gamma activity between γ 2 and γ 4. This signature is best seen in TW11, TW21 and TW35, and correlates with a clay and cinder horizon identified from the drill cuttings.

γ 2 - is a thin zone of very high natural gamma activity. From the drillhole logs, this zone is clay, silty clay or silty sand. The zone is underlain by rocks showing generally much lower natural gamma activity.

γ 1 - is a zone of increasing gamma activity in the form of two rather abrupt increases. Lithologically, this zone appears to be a weathered basalt. This signature was only observed in test wells TW3, TW9 and TW23.

Natural gamma correlations are most reliable in the southern and central portions of the site, particularly between test wells TW5, TW9, TW11, TW21, TW23, TW25, TW32 and TW35. Stratigraphic horizons γ 2 and γ 4 are recognized in all of these test wells, while γ 3 is best observed in test wells TW11, TW21, TW32 and TW35 (Plate 2). Correlation between test wells in the northwest plant site area (TW28 and TW18) and test wells further south is poor. It appears that the γ 1, γ 2 and γ 3 horizons are present in TW18, while only the γ 3 horizon is present in TW28. Correlatable features were not observed in TW13.

4.5 Well Hydraulics Testing

4.5.1 General

Data reduction and analyses used to evaluate the individual well tests are discussed in detail in Volume 2. A summary of the calculated aquifer parameters is presented in Table 4.3.

Tests run on the 4 inch test wells provide an order of magnitude estimate of transmissivity within the immediate vicinity of the test well. These test results may be adversely affected by the type of well completion and possible wellbore damage during well completion, leading

TABLE 4.3

RESULTS OF WELL TESTING

TEST WELL NUMBER	ANALYSIS METHOD	TRANSMISSIVITY (ft^3/day/ft)	STORATIVITY (Dimensionless)	VERTICAL HYDRAULIC CONDUCTIVITY (ft^2/day/ft)	DRAWDOWN IN PUMPED TEST WELL (ft)	DRAWDOWN IN PAIRED TEST WELL (ft)
TW3	Jacob	2,350	-	-	0.68	0.53 (TW4)
	Jacob	1,630	-	-		
	Theis R.	1,730	-	-		
TW4	Hvorslev	11.1	-	-	108	0.08 (TW3)
TW5	Jacob	14.3	-	-	43.45	0.01 (TW6)
	Theis R.	10.7	-	-		
TW6	Jacob	8,670	-	-	0.39	0.02 (TW6)
	Theis R.	9,690	-	-		
TW7	Jacob	477	-	-	1.33	0.07 (TW8)
	Theis R.	538	-	-		
TW8	Hvorslev	11.1	-	-	75	TW7 Not Measured
TW9	Hvorslev	6.9	-	-	39	-
TW10	Jacob	2,650	-	-	1.13	0.03 (TW7)
	Theis R.	2,250	-	-		
TW20/TW19	N.M.	-	-	4.7×10^{-5}*	19.0 †	-
TW25	Hvorslev	0.46	-	-	67.28	-
TW34	Hvorslev	1.76	-	-	39.52	-
PW1/PW2	Theis D.	230,000	3.1×10^{-5}	-		
	Theis D.	170,000	5.4×10^{-5}	-		
	Jacob	210,000	-	-		
	Jacob	270,000	-	-		
	Theis R.	300,000	-	-		

* Value for Basalt
† Estimated

NOTES:
- Jacob = Jacob Semi Log Analysis (Cooper and Jacob, 1946)
- Theis R. = Theis Recovery Method (Theis, 1935)
- Hvorslev = Modified Hvorslev (1951) Method
- Theis D. = Theis Drawdown Type Curve Method (Theis, 1935)
- N.M. = Neuman and Witherspoon Ratio Method (1972)

to an underestimate in the transmissivity of the formation materials. Due to the localized nature of the tests, the results cannot be applied directly to a large scale site conceptual model.

4.5.2 Existing Test Wells

Pump test data from test wells TW3, TW5, TW6 and TW7 were analyzed using the Jacob drawdown (Cooper and Jacob, 1946) and Theis (1935) recovery methods. Slug test data from test wells TW4 and TW8 were analyzed by a modified Hvorslev (1951) method. These methods enabled the transmissivity of the screened zones to be calculated. Storativity could not be calculated since no two test wells were completed in the same zone at a particular well nest site. Transmissivity values from the tests range over four orders of magnitude, 0.5 to 9200 ft^3/day/ft (Table 4.3).

During the tests, measurable drawdowns occurred in all cases where water levels were monitored in the other test well in the well nest (Table 4.3). However, only in the case of the TW3-TW4 well nest are the data conclusive (recovery data verified the drawdown data). These two test wells, although completed at different depths, are in direct hydraulic communication. The hydraulic response is suggestive of construction difficulties rather than a classical formation response. Hydraulic communication (formation type response) between TW5 and TW6 is possible; however, the data collected during the testing are not conclusive (anomalous water level recovery data - see Volume 2). No hydraulic communication between TW7 and TW8 is suggested, however, the data collected during the testing are not conclusive (anomalous water level recovery data - see Volume 2).

4.5.3 New Test Wells

Air lift tests carried out as part of well development gave a qualitative indication of hydraulic response/communication between the test wells at a well nest site.

Drawdowns recorded in the non-developed test wells at a particular site ranged from 0.0 to 0.4 ft (Table 4.4). Test wells suggestive of formation type hydraulic response (recovery data verified by drawdown data) are as follows: TW13 and TW15; TW19 and TW20; TW22 and TW24; TW26 and TW27; and TW31, TW32 and TW33. Additional data (water levels obtained during drilling of TW39) suggest a formation type response between TW20 and TW39. Hydraulic response suggesting construction difficulties was not observed in any of the new test wells. It should be noted that a lack of observed drawdown and/or recovery during this "testing" does not necessarily mean that the wells are hydraulically isolated.

In most cases following development, the water level in the well recovered to its equilibrium level immediately. The water level in test wells TW25 and TW34 recovered slowly enough for recovery measurements to be taken. These data were analyzed by the Hvorslev method and the results are presented in Table 4.3.

Data from the pump test carried out in TW9 were analyzed by a modified Hvorslev (1951) method. The pump test data from TW10 were analyzed by the Jacob semilog method (Cooper and Jacob, 1946) and the Theis (1935) recovery method. These methods provide an order of magnitude estimate for the transmissivity of the screened zone. Storativity could not be calculated from these well tests since no nearby wells were screened into the same zone. Analysis of the data from TW9 and TW10 indicate transmissivities of 7 ft^3/day/ft and 2450 ft^3/day/ft, respectively (Table 4.3).

TABLE 4.4

SUMMARY OF WELL DEVELOPMENT TESTING

Test Well Number	Pumping Rate / Method (gpm)	Duration of Test (minutes)	Drawdown in Test Well (ft)	Number	Comments
TW9	15 / P	1.5	–	–	No observation wells monitored
TW10	15 / P	45	0.03 0.00 0.00	TW7 TW8 TW9	
TW11	10 - 15 / A	70	0.00	TW12	
TW12	10 - 15 / A	60	0.00	TW11	
TW13	10 - 15 / A	60	0.00 0.07	TW14 TW15	
TW14	20 - 25 / A	60	0.00 0.00	TW13 TW15	
TW15	25 - 30 / A	60	0.15 0.00	TW13 TW14	
TW16	10 - 15 / A	35	0.03 –	TW17 TW18	 Well recovering after development
TW17	2 - 5 / A	35	0.00 –	TW16 TW18	 Well recovering after development
TW18	5 - 10 / A	35	0.00 0.00	TW16 TW17	
TW19	1 - 2 / B	30	– –	TW20 TW21	Not monitored Not monitored
TW20	50 / A	50	0.04 0.00	TW19 TW21	
TW21	5 - 8 / A	40	– 0.00	TW19 TW20	Not monitored
TW22	20 - 25 / A	55	0.00 0.24	TW23 TW24	
TW23	15 - 20 / A	55	0.00 0.00	TW22 TW24	
TW24	3 - 5 / A	55	>0.02 0.00	TW22 TW23	Well recovering after development
TW25	10 / A	<5	0.06 +0.02	TW26 TW27	 Water level rose in TW27
TW26	10 / A	60	– 0.07	TW25 TW27	Well recovering after development
TW27	1 / A	60	– –	TW25 TW26	Well recovering after development Well recovering after development
TW28	30 - 50 / A	5	0.03	TW29	Development stopped due to erosion around well
TW29	0.5 / A	63	0.00	TW28	
TW30	1 - 2 / B	30	–	–	No other test wells at this location
TW31	0.5 - 1.0 / A	60	0.02 0.05	TW32 TW33	
TW32	2 / A	60	0.00 0.40	TW31 TW33	
TW33	10 / A	60	0.17 –	TW31 TW32	 Stevens recorder malfunctioning
TW34	<0.5 / A	30	0.00 0.00 0.00	TW19 TW20 TW21	
TW35	1 - 2 / A	55	0.00	TW39	
TW36	5 - 8 / A	50	–	–	No other test wells at this location
TW37	2 - 3 / A	60	0.03 0.00	TW6 TW5	
TW38	0.5 / A	35	–	–	No other test wells at this location
TW39	20 - 25 / A	60	0.015 0.00	TW20 TW35	
TW40	<0.5 / A	30	–	–	No other test wells at this location

NOTES - Pumping Method
A - Airlift
B - Bailer
P - Submersible Pump

During the pump test in TW20, water level measurements could not be taken in test well TW20 due to the method of pumping (airlift). However, data from test well TW19 (an observation well for the TW20 pump test) was analyzed by the Neuman and Witherspoon Ratio Method (1972). This method provides an estimate of aquitard vertical hydraulic conductivity due to the pumping of an overlying/underlying aquifer. A value of vertical hydraulic conductivity for the basalt of 4.7×10^{-5} ft^2/day/ft is calculated by this method (Table 4.3). It is, however, important to point out that not all of the assumptions necessary to analyze the pump test data by this method were fulfilled. As a result, the value is considered to be a lower bound value for the basalt in the immediate vicinity of test well TW19.

Drawdown response to the pumping of TW20 was also observed in TW34. This well is completed in a cinder and clay zone beneath the cinder zone screened in TW20. Data from TW34 were not analyzed by the ratio method, since it is considered that the well is screened in materials that may comprise the lower part of the same aquifer, making the use of the Ratio Method inappropriate. No other measurable drawdowns were recorded in other test wells instrumented during the TW20 pump test. Calculations (based on the Theis equation) indicate that test wells within a radius of about 1000 ft of the pumped well and screened within the same zone as the pumped well should have recorded a drawdown of approximately 5 ft during the time frame of the test (24 hours). Test wells TW7 and TW12 were anticipated to have shown a water level decline (test wells TW36 and TW39 were not completed when the test was run). No measurable drawdown was recorded in either TW7 or TW12. It therefore appears that either hydraulic barriers or anisotropy exists within the system.

4.5.4 Plant Production Wells

Data from the testing of the plant production wells were analyzed by the Theis (1935) drawdown method, the Jacob (Cooper and Jacob, 1946) method and the Theis (1935) recovery method. Full details of these analyses are presented in Volume 2. The Theis drawdown method and the Jacob method were used to calculate formation transmissivity and storativity values. The Theis recovery method can only be used to calculate transmissivity. The hydraulic parameters obtained using the above analyses are more representative of bulk aquifer parameters than those provided by the short term pump tests.

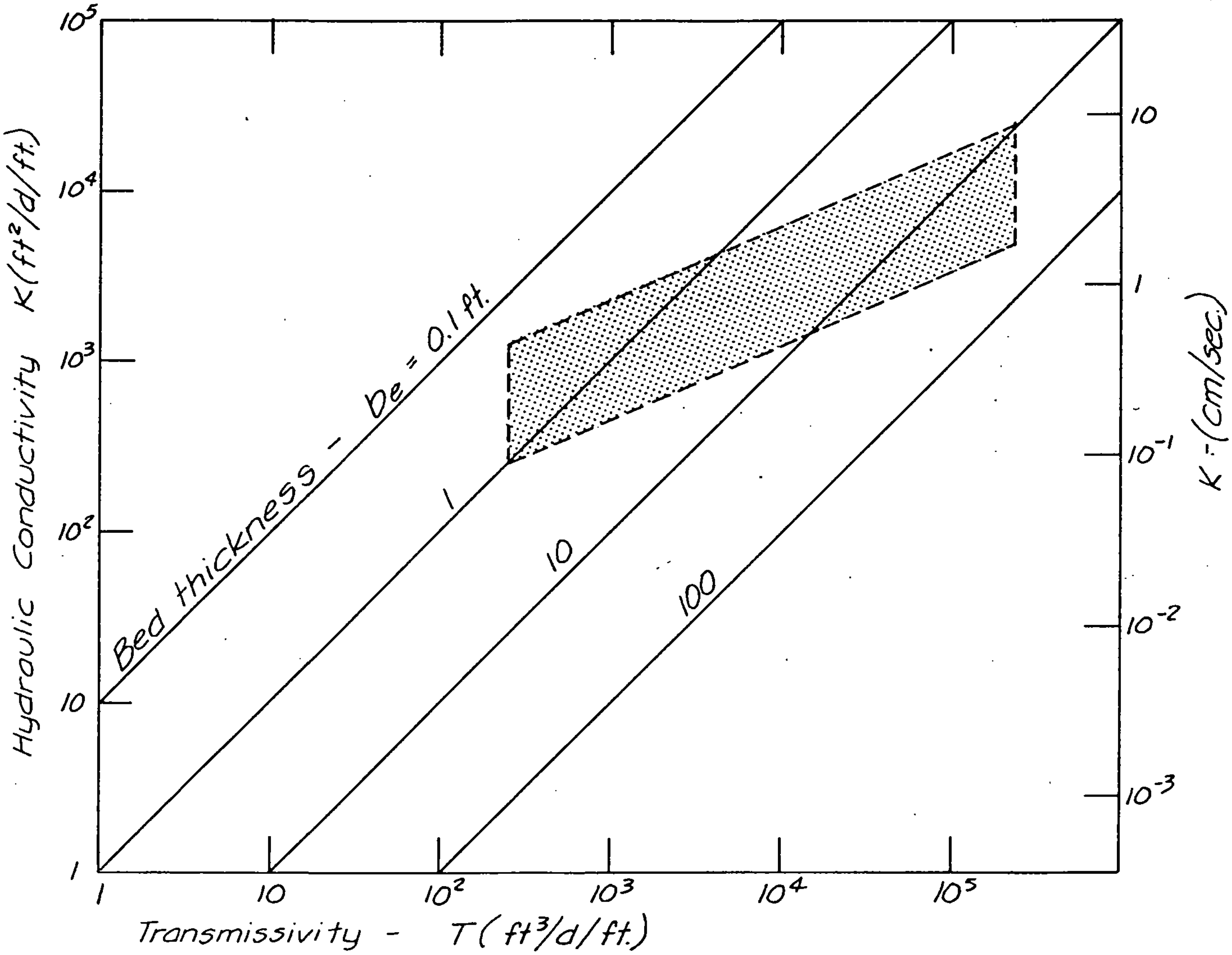
Data from the drilling program indicates that most of the ground water produced from an open borehole is from cinder zones. These zones consist of unconsolidated and very porous scoriaceous material. Therefore, when calculating the hydraulic conductivity of the principal water bearing units from transmissivity values, the effective (cumulative) thickness of the principal water bearing units penetrated by the well should be used instead of the saturated flow system thickness.

Analysis of water level data from PW1 during the intermittent pumping of PW2 indicates a transmissivity for the water bearing sequence ranging between 1.7 to 3.0 x 10^5 $ft^3/day/ft$ and a storativity ranging between 3.1 to 5.4 x 10^{-5}. Assuming a flow system thickness of 150 ft the hydraulic conductivity and specific storage of the sequence range between 1.1 and 2.0 x 10^3 $ft^2/day/ft$ and 2.1 to 3.6 x 10^{-7}, respectively.

Figure 4.3 shows the relationship between transmissivity and hydraulic conductivity for various assumed values of effective thickness.

RELATIONSHIP BETWEEN TRANSMISSIVITY AND HYDRAULIC CONDUCTIVITY FOR VARIOUS VALUES OF EFFECTIVE THICKNESS

Figure 4.3



Estimated conditions pertaining to cinder zones.

Note : Select transmisivity value x axis, run vertical line to intersect bed thicknesses. Select appropriate bed thickness and then read hydraulic conductivity from y axis in either imperial or metric units.

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Transmissivity derived from the plant production well test, as well as the range in transmissivity from the well tests, are shown on the graph. The shaded area indicates conditions considered to be applicable to the principal water bearing units. The estimated hydraulic conductivity of water bearing zone material ranges from 2.5×10^2 to 2.5×10^4 $ft^2/day/ft$. These values are considered relatively high for geological materials and would be similar to that of clean coarse sand to gravel.

Water levels in test wells TW25, TW26 and TW27 did not show any response to the intermittent pumping of PW2. Based on the Theis equation and assuming transmissivity and storativity values of 2.4×10^5 $ft^3/day/ft$ and 4.3×10^{-5}, respectively, and assuming a radius of 990 ft from PW2 to test wells TW25, TW26 and TW27, a drawdown of approximately 0.17 ft would be anticipated at this location due to the pumping of PW2 for 6 minutes at a rate of 680 gpm. Since no measurable drawdown was recorded, this appears to indicate that the ground water system is either anisotropic (a spatial change in aquifer parameters) or that a hydraulic barrier exists between the plant wells and the test wells. However, the lack of response could also be due to the steeply sloping water table preventing full propagation of the cone of depression.

Water levels in test wells TW24, TW26 and TW30 did not show any change in level when the plant production well pumping schedule was switched over (PW3 pumping continuously, PW1 pumping intermittently and PW2 idle) for six hours (see Section 3.5.4). This also appears to indicate that either anisotropy or hydraulic barriers may exist within the system. However, the lack of response could also be due to the steeply sloping water table immediately north and west of the plant wells preventing the full propagation of the cone of depression in these directions.

4.6 Hydrochemistry

4.6.1 Drilling and Well Development Sampling

Water quality data collected during the drilling and well development programs (water temperature, conductivity, pH, Eh and fluoride concentrations), are presented on the field borehole logs and field sheets in Volume 2. A summary of the test well development hydrochemistry is presented on Table 4.5. Full chemical analyses carried out by Northern Engineering and Testing on well development samples are presented in Volume 3.

In general, the pH and Eh of the ground water, recorded during drilling and well development, were significantly affected by aeration. However, subtle changes in pH recorded during the drilling of some test wells were useful in indicating a different water chemistry/aquifer. For example, during the drilling of test well TW9, the pH dropped from 7.8 to 7.3 below a depth of 30 ft, indicating a different water chemistry/aquifer below this depth.

Ground water conductivity measurements were also useful in indicating a different water chemistry/aquifer. For example, while drilling TW11 ground water from the first water bearing zone (a cinder zone) showed a conductivity of approximately 1500 μ mho/cm and a pH of 8.5. Subsequently, the boreole penetrated a sandy gravel aquifer and the ground water conductivity and pH declined to 1000 μ mho/cm and 7.2, respectively.

The ground water fluoride concentration was recorded using a fluoride ion electrode on a regular basis during drilling/well development. These data provided preliminary information used to assess the hydrogeological environment and aid in additional drill site selection. For example, during the drilling of TW34, fluoride concentrations of approximately 4 mg/l were recorded as the borehole penetrated a weathered

TABLE 4.5

WELL DEVELOPMENT HYDROCHEMISTRY

TEST WELL NUMBER	METHOD OF DEVELOPMENT	TEMPERATURE	pH	Eh (mV)	CONDUCTIVITY (μmho/cm)	Fluoride† (mg/l)
TW9	Pump	8.5	6.2	+ 30	1300	0.27
TW10	Pump	14	6.6	+170	1050	1.5
TW11	Air	11	8.0	+141	1100	-
TW12	Air	9.5	7.7	+141	1450	-
TW13	Air	9	7.8	+208	600	0.25
TW14	Air	10	7.7	+220	600	0.35
TW15	Air	11.5	7.8	+242	600	0.26
TW16	Air	9	7.9	-	1150	7.4
TW17	Air	8	8.4	-	1350	7.9
TW18	Air	7	7.9	-	1100	0.34
TW19	Bailer	NO MEASUREMENTS TAKEN				
TW20	Air	5	7.5	+323	750	2.15
TW21	Air	6	7.5	-	1100	0.31
TW22	Air	8.5	7.6	-	1800	6.4
TW23	Air	6	7.5	-	1150	1.3
TW24	Air	6	8.6	-	1400	9.3
TW25	Air	9.5	6.5	-	1350	-
TW26	Air	8	7.5	+ 76	1300	0.81
TW27	Air	7	7.7	+ 72	1200	5.4
TW28	Air	8	6.7	+219	900	0.35
TW29	Air	5.0	7.5	+178	775	0.48
TW30	Bailer	NO MEASUREMENTS TAKEN				
TW31	Air	2.0*	8.8	-	375	0.48
TW32	Air	4.0*	10.8	-	2525	0.30
TW33	Air	6.0	7.7	+101	525	0.275
TW34	Air	6.0	8.5	-	600	1.35**
TW35	Air	7.5	7.5	-	1300	0.33
TW36	Air	8.0	6.9	-	1000	11.2
TW37	Air	8.5	7.1	-	1650	21.5
TW38	Air	3.5*	7.3	-	550	0.62
TW39	Air	6.0	7.7	-	1010	9.7
TW40	Air	5.5	7.1	-	3275	11.0

† Monsanto Laboratory

* Measurements affected by air temperature.

**After 3 well volumes evacuated, probably reflects mixing of water during drilling.

basalt and cinder zone between 39 and 66 ft below ground surface. Test well TW20, located nearby in the same well nest and screened in the same cinder zone, showed a fluoride concentration of 1.1 mg/l under static conditions and 2.15 mg/l during well development. As a result of these findings, TW20 was subsequently pump tested (see Section 4.5.3). The water quality of the discharge water is shown on Table 4.6. Based on the results of the pump test and water chemistry, it appeared that pumping induced fluoride enriched ground water to flow toward the pump test site. In order to locate the area of high fluoride water, test wells TW35, TW36 and TW39 were subsequently drilled.

4.6.2 Primary Sampling Program

Chemical analyses of the ground water samples are presented in Appendix B, Tables B.1 and B.2, for the first and second sampling periods, respectively.

The parameters of concern at the Monsanto site as stated in Section 1.3 are fluoride, cadmium, selenium, sulfate, chloride and vanadium. Tables 4.7 and 4.8 summarize the concentration of these targeted parameters in those test wells where the concentrations of at least one ion exceed drinking water standards. Fluoride, selenium and cadmium have been listed by the U.S. Environmental Protection Agency (EPA) as Primary Drinking Water parameters. The Drinking Water Standards are as follows for each parameter:

- Fluoride = 2.4 mg/l
- Cadmium = 0.010 mg/l
- Selenium = 0.01 mg/l

TABLE 4.6

DISCHARGE WATER FROM TW20

DATE (1984) - TIME	ELAPSED TIME (mins)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (μmho/cm)	pH	FLUORIDE (mg/1)
12/15 - 1337	2	14.0	700	-	2.95
12/15 - 1356	21	14.0	600	-	3.0
12/15 - 1500	85	9.0	700	6.82	3.20
12/15 - 1650	195	6.5	700	6.93	3.15
12/15 - 2215	520	6.0	425(?)	6.81	3.15
12/16 - 0340	845	8.0	800	7.12	2.90
12/16 - 0840	1145	8.5	650	7.20	3.10
12/16 - 1210	1355	14.0	675	-	3.10

Note: Temperature, specific conductance and pH measured by Golder Associates.

Fluoride measured by Monsanto laboratory.

In general, there were few significant changes from the fall to winter sampling period. Changes that did occur show a slight increase in fluoride, cadmium and selenium. Two noteworthy changes were witnessed in TW6 and TW24 for cadmium. In both cases, the cadmium concentration decreased. It is possible that sampling procedures could have affected the water quality. However, it is likely that the increase in pH value for TW24 (considered to be caused by leakage of the grout liquor) could be an explanation; the increase in pH would cause precipitation of the oversaturated cadmium.

4.6.3 Quality Control (QC)/Quality Assurance (QA)

Northern Engineering and Testing's laboratory conducted internal QC on the received water samples, which included replicate analysis on a minimum of 10 per cent of the received samples for precision and spiking and analyzing aliquots from a minimum of 10 per cent of the samples for accuracy. Internal QC in the laboratory also involved routine calibration on standardized solutions of analyzed parameters. During each of the primary sampling phases (November to December, 1984, and February to March, 1985) the QC program included six blank samples that were sent to the laboratory for evaluating representativeness. During the second sampling period QC data were increased by splitting five samples and spiking several aliquots of samples with either trace metals or fluoride and nitrate. The laboratory was unaware of these "field" splits and spikes.

Precision, accuracy, completeness and representativeness were evaluated from the QC data generated by both sampling phases. Table 4.9 presents the summarized results of the November and December, 1984, sampling period, which includes laboratory replicate analyses and spiked aliquot analyses. Table 4.10 presents the same, except for the February and March, 1985, sampling period. Table 4.11 summarizes the results of field splits and spiked aliquot analyses.

TABLE 4.9

SUMMARY OF QUALITY CONTROL RESULTS
ON LABORATORY REPLICATE AND SPIKED SAMPLES
FOR NOVEMBER/DECEMBER, 1984, SAMPLING

(mg/l)	No. of Samples	PRECISION (Mean CV)	No. of Samples	COMPLETENESS FOR PRECISION (%)	No. of Samples	ACCURACY (Mean Recovery %)	No. of Samples	COMPLETENESS FOR ACCURACY (%)
Total Dissolved Solids	6	0.054	6	83				
Calcium	17	0.036	17	88	5	93	5	100
Magnesium	16	0.036	16	94	5	99	5	100
Sodium	16	0.114	16	88	5	95	5	100
Potassium	5	0	5	100	3	101	3	100
Total Alkalinity	5	0.010	5	80	3	108	3	100
Chloride	6	0.026	6	100	5	98	5	100
Fluoride	6	0.019	6	100	4	98	4	100
Nitrate & Nitrite	6	0.008	13	100	4	96	4	100
Sulfate	13	0.151	7	69	3	92	3	100
Arsenic	1	0.106	3	100	4	84	4	50
Cadmium	*	*	6	100	4	86	4	75
Chromium	1	0.129	6	100	3	87	3	100
Iron	3	0.133	6	100	3	101	3	100
Lead	3	0.203	6	100	2	98	2	100
Manganese	2	0.099	6	100	3	97	3	100
Selenium	1	0	6	100	4	105	4	100
Silver	2	0.283	6	100	4	105	4	50
Vanadium	2	0.220	5	100	4	97	4	75
Zinc	6	0.100	9	89	6	86	6	83

*Results were below detection, therefore CV's cannot be calculated.

4.6.3.1 Precision and Accuracy

Intra-laboratory precision is determined from the replicate analyses performed. Precision is expressed as the coefficient of variation (CV). A record of the precision of most analyses is kept by calculating and recording the coefficient of variation of the pairs or triplicates for each parameter.

Acceptable CV values for inorganic anlayses (metals and ions) are dependent on the concentration range of the parameter within the particular replicate analysis. Below is the minimum acceptable CV value for inorganic parameters to Golder Associates for the Monsanto site, based on previous experience.

Concentration Level	Acceptable CV
Detection limit to 10 times detection limit	0.35
10 times detection limit to 100 times detection limit	0.14
Greater than 100 times detection limit	0.07

Accuracy is estimated from the analysis of standard reference solutions (SRS) and spiked aliquots of actual samples. Accuracy is expressed as a per cent recovery for each parameter.

Acceptable recoveries for inorganic analyses are dependent on the concentration range of the parameter and also on the precision of fabricating the standard reference solutions (SRS) and spiked aliquots of samples. Below are the minimum acceptable recoveries for inorganic parameters to Golder Associates (based on previous experience) by concentration range (assuming SRS were precisely made and added to aliquots of samples):

Concentration Level	Acceptable Recovery (%)
Detection limit to 10 times detection limit	40 to 160
10 times detection limit to 100 times detection limit	60 to 140
Greater than 100 times detection limit	80 to 120

A word of caution is warranted on evaluating the adequacy of chemical analyses based on Mean CV's and Mean Recovery (%). Acceptable CV's and Recovery are dependent on the level of concentration of each parameter, either in the sample or spike. Mean CV's and Recovery are more easily evaluated if the number (n) of replicate (split) and spiked samples are statistically significant. Some of the parameters had n values as small as four, which represented only 10 per cent of the total number of wells sampled. To overcome this short coming, each CV and Recovery was evaluated separately and are summarized by Completeness (%).

4.6.3.2 Completeness

Completeness represents the percentage of individual QC results that are acceptable. Completeness is a summary of all the QC evaluations for an appropriately large number of CV's for precision, and Recoveries for accuracy. Completeness is determined as a percentage of acceptable data to the total amount of data. The assumption is made that if 10 per cent of the samples have QC data, the QC will adequately represent the uncontrolled sample data.

Based on previous experience, Golder Associates considers 90 per cent for Completeness (%) adequate for laboratories. Completeness evaluations indicated two problems with laboratory analyses of the water quality samples. The precision of the sulfate analyses is not acceptable and the accuracy of the arsenic analyses is also not acceptable. The Completeness (%) for sulfate CV is 69 and 62 per cent for the fall and winter sampling periods, respectively. The corresponding values for Completeness (%) on arsenic recovery is 50 and 56 per cent, respectively. In summary, sulfate analyses can be considered to be valid, but not very exact, while arsenic analyses may not be valid at low concentrations.

Other Completeness values that are below 90 per cent (Tables 4.9 and 4.10) are suspect, but cannot be considered unacceptable since most represent only one CV or Recovery beyond limits. The generally poor Completeness for field spiked samples and particularly poor accuracy for selenium and cadmium analyses at levels near the detection limits (Table 4.11) may reflect not only laboratory, but also field fabrication problems establishing the spiked sample.

In summary, the results of QC indicate that there is good confidence in Northern Engineering Laboratory's analyses with the exception of sulfate and arsenic analysis which are fair to poor. It is also possible that the cadmium and selenium analyses are not accurate at concentrations near the detection limits for the particular ion.

4.6.3.3 Representativeness

The evaluation of blank sample analyses (representativeness) is more subjective than calculating minimum acceptable limits. If the analyses of blank samples indicate a problem may exist, the problem could affect the entire sample batch. Rarely does a blank sample evaluate a single potential influence, but rather the difference between samples may help isolate problems. Therefore, a real problem to all or most samples should show up systematically in most or several blank samples, instead of a single blank.

The purpose of blank samples was to provide data to determine if the chemistry of the samples could potentially be impacted by the atmosphere, the distilled water used for cleaning, cross-contamination between samples, sample containers, the filtering process or the preservatives. The analytical results of the blanks for each sampling period are presented in Appendix B. These results indicate that vanadium was detected in three of the six blanks during the first sampling period. The concentrations (between 0.03 and 0.04 mg/l) were just above the detection limit of 0.02 mg/l. During the second sampling period, the detection limit was 0.05 mg/l, and thus spurious detection of vanadium was not observed. One noteworthy blank sample (Lab 1) from the second sampling period showed several trace metals (arsenic at 0.014 mg/l, iron at 0.08 mg/l and zinc at 9.06 mg/l). Since none of the other blank samples analyzed contained any of these metals or other trace metals above detection, it does not appear to be a systematic problem with either sampling or analytical techniques.

4.6.4 Ground Water Types

The results of the chemical analysis were inspected to characterize the samples into groups. Grouping the samples by water quality aids in the understanding of the hydrogeological regime and in the interpretation of the results. Three methods were used to group the ground water:

- o Stiff diagrams,
- o Statistical treatment - factor analysis and cluster analysis using the PMDP statistical package (Department of Biomathematics, University of California, 1981), and
- o Inspection of data

Each method has limitations. The Stiff diagrams (presented in Appendix B) reflect only the major cation-anion water quality. The statistical treatment involves a multi- component analysis of all water quality parameters, but does not consider spatial ? special relationships among the water samples. The computer outputs from the statistical package are presented in Volume 3. Inspection of the data is more subjective, but considers spatial relationships and probable flow system scenarios.

Based on a combination of the above methods, two major natural water groups have been identified, fresh water (Shallow Ground Water System) and soda water (Chesterfield Range System). The water from each group can be subdivided into the following:

- o Background water,
- o Water containing fluoride, cadmium and/or selenium slightly above background levels,
- o Water containing fluoride, cadmium and/or selenium above the recommended drinking water standards, and
- o Water containing vanadium, ammonia, sulfate and/or chloride above background levels.

Table 4.12 shows the water samples by group and subgroup. With the exception of TW25 and TW28, there were no differences between the two sampling periods. TW25-TW28 are considered to belong to the fresh water group in the November/December, 1984, sampling, but fall within the soda water group in the February/March, 1985, period. These wells may not have been developed thoroughly before sampling in the fall, or there may be seasonal fluctuations in water quality.

4.6.5 Ground Water Quality Trends

The new water quality data represent only two measurement points in time for each well. It is thus not possible to describe geochemical trends for the new test wells. However, water quality trends can be updated for the older test wells, the production wells and the offsite wells/springs. Referring back to Figures 2-2 through 2-6, inclusive, significant changes are apparent for fluoride in TW5, TW6 and SWG, for cadmium in TW6 and PW3, and for selenium in TW5, TW6, SWG and PW3. Fluoride shows a trend of increasing concentration in TW5, TW6 and SWG. There is no increase in fluoride concentration in PW3.

The trend in cadmium concentration for TW6 has been similar to the trend/fluctuation in TW5, except for the last sampling period where a dramatic decrease in cadmium concentration was recorded. Such a dramatic decrease in cadmium concentration is unlikely in a short time period, and thus the results of the last sampling and analysis period for cadmium in TW6 is suspect. The cadmium concentration in PW3 remained near or slightly above the primary drinking water standard of 0.010 mg/l. It should be noted however, that the accuracy of the cadmium concentrations appear doubtful at concentrations close to the drinking water standard.

Selenium concentrations have shown a reduction in each of the wells TW5, TW6, SWG and PW3. Although the sampling procedure was changed for TW5 and TW6 (previously installed submersible pumps had been removed and sampling included airlifting and bailing as described in Section 3.6.4.), there was no change in sampling procedure for SWG or PW3. It is thus not likely that the reduction in selenium concentration is a

TABLE 4.12

WATER SAMPLE GROUPS

Fresh Water

BACKGROUND WATER	WATER WITH F AND USUALLY Cd, Se, SO_4 and Cl SIGHTLY ABOVE BACKGROUND	WATER WITH F AND USUALLY Cd, Se, SO_4 and Cl CONSIDERABLY ABOVE BACKGROUND	OTHER WATER WITH V AND SOMETIMES NH4, SO_4 AND Cl ABOVE BACKGROUND
TW2, TW13, TW14, TW15, TW34, TW38, Lewis, Nelson	PW2, PW3, TW19, TW20, TW26, Effluent	PW1, TW5, TW6, TW16, TW17, TW22, TW24, TW27, TW30, TW36, TW37, TW39, TW40, SWG, Mormon Spring, Calf Spring	TW11, TW12, TW31, TW32, TW33, SWC

Soda Water

BACKGROUND WATER	WATER WITH F AND USUALLY Cd, Se, SO_4 and Cl SLIGHTLY ABOVE BACKGROUND	WATER WITH F AND USUALLY Cd, Se, SO_4 and Cl CONSIDERABLY ABOVE BACKGROUND	OTHER WATER WITH V AND SOMETIMES NH4, SO_4 AND Cl ABOVE BACKGROUND
TW3, TW4, TW7, TW8, TW9, TW18, TW21, TW25, TW28*,TW29*, TW35, Hooper Springs, Dock Springs	TW10*, TW23*, SW Spring*		

* Some suggestion of mixture of fresh and soda water.

result of new sampling procedures. Further data are required to assess the rather large fluctuations in selenium concentrations.

4.7 Water Level Monitoring

4.7.1 General

All water level data obtained during the field program are shown in Appendix C. The Appendix also contains water level elevation hydrographs for each test well. For multiple well monitoring sites (well nests), the appropriate hydrographs are superimposed on the same plot.

4.7.2 Water Level Hydrographs

Water level hydrographs generally show decreasing water levels during the monitoring period lasting from July, 1984, to February, 1985. This decrease in water level was anticipated, since fall and winter are generally periods of low aquifer recharge. It is likely that ground water levels will rise during the spring.

For multiple well monitoring sites, different water levels are generally observed for test wells completed at different depths, indicating some component of vertical flow between hydrostratigraphic units. Also, superimposed hydrographs from wells within the same nest generally have very similar shapes (i.e. rise and fall in unison). These data suggest that vertical leakage may occur in the hydrologic system.

The water levels in some test wells exhibited diurnal (24 hour) and semidiurnal (12 hours) oscillations that were more or less sinusoidal in nature. The amplitude of the water level oscillations ranged from 0.01 to 0.035 ft, depending on the test well location and the type of oscillation. Semidiurnal oscillations were observed during the new and full moon and diurnal oscillations occurred during the first and last quarters. As a result, it was concluded that the observed water level fluctuations represented hydraulic responses to earth tides (Volume 2).

Two important observations were noted after review of the water level monitoring records:

1) Water level oscillations were observed in test wells TW3, TW4, TW5, TW9, TW18, TW21 and TW23. These test wells are all completed deeper than 100 ft below the water table.

2) With exception of two test wells, TW7 and TW26, water level oscillations were not observed in test wells completed within 100 ft of the water table (TW6, TW8, TW10 through TW17, TW19, TW20, TW22, TW24, TW28, TW30, TW31, TW34 and TW36).

Test wells not included above have either inconclusive records or were not completed and/or instrumented.

A decrease in the vertical hydraulic conductivity of the basalt sequence with increasing depth below land surface is believed to be the cause of tidal induced water level oscillations only being recorded at depth within the hydrological system. At depth within the system (i.e. greater than about 100 ft below the water table), low vertical hydraulic conductivities appear to prevent attenuation of the earth tide response via upward leakage. However, at shallow depths, higher vertical hydraulic conductivities appear to result in attenuation of the earth tide response as rapidly as the response is induced.

Based on the analysis described in Volume II, earth tide water level responses have been used to estimate a specific storage value of 3.3×10^{-7} ft^{-1} for the hydrogeological system. This value is in very close agreement with that obtained from the plant production well pump testing.

To evaluate the probable vertical hydraulic conductivity of the system at shallow depths, a two layer conceptual model of the physical system was formulated (Volume 2). Based on the solution of an analogous heat flow problem, a lower-bound value for vertical hydraulic conductivity of 3×10^{-2} ft^2/day/ft is calculated. This lower-bound value for vertical hydraulic conductivity is considered an order of magnitude estimate.

4.7.3 Potentiometric Data

Potentiometric data for February 15th, 1985 (except for TW40, where the water level was measured on February 17th, 1985), is summarized in Table 4.13. The table also includes the direction and magnitude of the vertical components of the hydraulic gradient between individual test wells at a well nest site.

In general, these data show that for the upper two test wells completed within the basalt sequence at a particular well nest site, there is a negligible difference in the potentiometric elevation measured in each test well. Examples include TW37 and TW6, TW16 and TW17, TW19 and TW20, TW22 and TW24 and TW28 and TW29. These test wells are generally completed at depths up to 60 ft. below the water table.

There is however a measurable vertical component of hydraulic gradient between the upper two test wells and the lower test well(s) at a particular well nest site within the basalt sequence. The vertical component of hydraulic gradient is predominantly downward in the west central and east central portions of the site, while upward vertical components of hydraulic gradient are present along the southern boundary of the site (Figure 4.4). In other portions of the site, data are insufficient to allow definitive conclusions regarding vertical flow components.

TABLE 4.13

POTENTIOMETRIC DATA

TEST WELL NUMBER	GROUND ELEVATION (ft)	ELEVATION OF COMPLETION INTERVAL (ft)		WATER LEVEL ELEVATION (ft)	COMPONENT OF HYDRAULIC GRADIENT	
		Top	Bottom		Direction	Magnitude
TW2+	5989*	5915	5729	5937.22	-	
TW4	5880.07	5774	5754	5878.61		
					N	
TW3	5880.26	5700	5630	5878.64		
TW37	5957.10	5870	5857	5890.99		
					N	
TW6	5957.10	5851	5831	5890.99		
					D	0.041
TW5	5956.97	5757	5736	5887.12		
TW10	5884.44	5866	5857	5871.19		
					U	0.010
TW7	5884.46	5850	5824	5871.43		
					U	0.051
TW8	5884.67	5809	5789	5873.38		
					U	0.029
TW9	5883.85	5648	5631	5878.09		
TW12	5937.63	5853	5837	5870.82		
					U	0.012
TW11	5936.62	5808	5800	5871.33		
TW14	5986.46	5973	5962	5975.91		
					D	0.080
TW15	5986.48	5938	5926	5973.07		
					U	0.030
TW13	5986.43	5907	5888	5974.09		
TW16	5996.85	5928	5920	5935.69		
					N	-
TW17	5996.42	5901	5881	5935.66		
					U	0.013
TW18	5994.62	5775	5756	5937.26		
TW19	5891.20	5868	5862	5869.05		
					N	-
TW20	5891.76	5856	5847	5869.03		
					N	-
TW34	5891.62	5824	5817	5868.99		
					U	0.018
TW21	5891.46	5786	5768	5873.68		
TW24	5952.49	5879	5860	5885.0		
					N	-
TW22	5952.44	5848	5840	5885.04		
					D	0.024
TW23	5952.35	5781	5762	5883.33		

*Estimated

TABLE 4.13 (Cont'd)

TEST WELL NUMBER	GROUND ELEVATION (ft)	ELEVATION OF COMPLETION INTERVAL (ft)		WATER LEVEL ELEVATION (ft)	COMPONENT OF HYDRAULIC GRADIENT	
		Top	Bottom		Direction	Magnitude
TW27	5995.50	5908	5902	5908.90	D	0.067
TW26	5995.58	5860	5853	5905.66	D	0.002
TW25	5995.80	5816	5804	5905.56		
TW29	5987.70	5948	5940	5949.13	N	–
TW28	5986.96	5911	5898	5949.12		
TW30	5990.98	5929	5922	5930.93	–	–
TW31	5973.88	5952	5944	5952.04	D	0.023
TW33	5974.03	5907	5899	5950.99	D	0.008
TW32	5974.09	5823	5796	5950.21		
TW39	5894.99	5847	5839	5869.02	U	0.027
TW35	5895.03	5824	5806	5869.77		
TW36	5904.66	5856	5850	5880.45	–	–
TW38	5970.94	5882	5869	5885.95	–	–
TW40	5988.32	5906	5899	5906.23	–	–
PW1+	5987.60	5897	5787	5887.78	–	–
PW2+	5987.52				–	–
PW3+	5989.51	5879	5734	5875.11	–	–
Nelson	6021*	5916	5874	5945*	–	–
SWC	5910*	UNKNOWN		UNKNOWN	–	–
SWG	5874.82	5829	5810	5865*	–	–
Lewis	5860*	5841	5755	3835*	–	–

*Estimated

NOTES:

1) Test wells grouped by site; listed in order of increasing depth.
2) Water levels as at February 15th, 1985, except TW40 which was at February 17th, 1985.
3) Component of hydraulic gradient as measured between test wells at each well nest:
   - U = indicates upward component
   - D = indicates downward component
   - N = indicates negligible upward or downward component

\+ These wells are open over the Upper and Lower Basalt Zones; the potentiometric level therefore represents a combination of the potentiometric levels from various horizons open to the wells.

COMPONENT OF HYDRAULIC GRADIENT BETWEEN TEST WELLS AT WELL NEST SITES

Figure 4.4

Golder Associates

TABLE 4.10

SUMMARY OF QUALITY CONTROL RESULTS
ON LABORATORY REPLICATE AND SPIKED SAMPLES
FOR FEBRUARY/MARCH, 1985, SAMPLING

(mg/l)	No. of Samples	PRECISION (Mean CV)	No. of Samples	COMPLETENESS FOR PRECISION (%)	No. of Samples	ACCURACY (Mean Recovery %)	No. of Samples	COMPLETENESS FOR ACCURACY (%)
Total Dissolved Solids	7	0.015	7	100				
Calcium	9	0.015	9	100	7	99	7	100
Magnesium	9	0.007	9	100	7	96	7	100
Sodium	8	0.059	8	88	7	97	7	100
Potassium	7	0.057	7	86	7	98	7	100
Total Alkalinity	9	0.015	9	100	5	103	5	100
Chloride	9	0.033	9	89	8	104	8	100
Fluoride	6	0.015	6	100	7	99	7	100
Nitrate & Nitrite	7	0.054	7	86	6	101	6	100
Sulfate	8	0.144	8	62	5	99	5	100
Arsenic	1	0.094	3	100	9	106	9	56
Cadmium	5	0.115	8	100	7	94	7	86
Chromium	2	0	6	100	6	90	6	83
Iron	1	0	6	100	6	109	6	83
Lead	*	*	7	100	9	95	9	100
Manganese	*	*	6	100	5	91	5	80
Selenium	7	0.039	8	100	8	95	8	100
Silver	*	*	7	100	6	97	6	100
Vanadium	1	0.049	6	100	6	100	6	100
Zinc	3	0	6	100	6	97	6	100

*Results were below detection, therefore CV's cannot be calculated.

TABLE 4.11

SUMMARY OF QUALITY CONTROL RESULTS
ON FIELD SPLIT AND SPIKED SAMPLES
FOR FEBRUARY/MARCH, 1985, SAMPLING

(mg/l)	No. of Samples	PRECISION (Mean CV)	No. of Samples	COMPLETENESS FOR PRECISION (%)	No. of Samples	ACCURACY (Mean Recovery %)	No. of Samples	COMPLETENESS FOR ACCURACY (%)
Total Dissolved Solids	5	0.04	5	100				
Calcium	5	0.02	5	100				
Magnesium	5	0.02	5	100				
Sodium	5	0.04	5	100				
Potassium	5	0.08	5	100				
Total Alkalinity	5	0.01	5	80				
Chloride	5	0.03	5	100				
Fluoride	5	0.03	5	100	2	98	2	100
Nitrate & Nitrite	5	0.12	5	60	2	0	2	50
Sulfate	5	0.02	5	100				
Arsenic	2	0.23	5	100	2	81	2	50
Cadmium	1	0.25	5	100	2	58	2	50
Chromium	2	0.0	5	100	2	20	2	100
Iron	*	*	5	100				
Lead	1	0.0	5	100	2	80	2	100
Manganese	3	0.75	5	60				
Selenium	3	0.13	5	80	2	214	2	50
Silver	*	*	5	100		78	2	100
Vanadium	1	0.043	5	100	2			
Zinc	1	0.013	5	100				

*Results were below detection, therefore CV's cannot be calculated.

TABLE 4.7

SUMMARY OF TARGET IONS
WITHIN SELECTED SAMPLING LOCATIONS

November and December 1984 Period

Test Well Number	CONCENTRATIONS (mg/l)					
	F	Cd	Se	SO_4	Cl	V
TW5	10.7	0.211	ND	632	332	0.05
TW6	12.9	0.47	0.029	633	250	0.07
TW11	0.24	ND	ND	264	114	ND
TW12	0.25	ND	ND	475	233	0.61
TW16	7.43	1.41	N/A	222	121	N/A
TW17	8.14	0.087	0.008	338	301	0.03
TW22	9.33	0.07	0.023	847	313	0.13
TW23	1.31	0.034	0.007	455	112	0.03
TW24	3.58	0.039	0.026	464	233	0.09
TW26	0.63	0.011	0.006	456	152	0.04
TW27	4.11	0.039	0.048	414	71	0.06
TW30	2.38	ND	ND	389	141	0.07
TW33	0.39	ND	ND	53	20	0.27
PW1	1.73	0.192	ND	166	141	0.08
PW2	0.69	ND	ND	95	58	0.05
PW3	0.55	ND	ND	84	45	0.06
Calf Springs	8.14	ND	0.026	328	91	0.03
Mormon Springs	9.77	0.038	0.011	285	112	0.03
SWG	6.2	ND	ND	277	81	0.06
SWC	0.29	ND	ND	379	186	0.44
(EPA) Standards	2.4	0.01	0.01	250*	250*	—

*Recommended Concentrations for Standard Drinking Water

All other samples recorded concentrations less than drinking water standards.

ND = Not Detected (below detection limit)

N/A = Not Analyzed

TABLE 4.8

SUMMARY OF TARGET IONS WITHIN SELECTED SAMPLING LOCATIONS

February and March 1985 Period

Test Well Number	CONCENTRATIONS (mg/l)					
	F	Cd	Se	SO4	Cl	V
TW5	12.3	0.348	0.010	640	230	ND
TW6	14.4	0.007	0.026	622	230	ND
TW11	0.27	ND	ND	195	107	ND
TW12	0.28	ND	ND	574	302	0.67
TW16	8.05	1.49	0.173	194	115	0.24
TW17	6.61	0.027	0.012	316	302	ND
TW20	2.68	ND	0.006	244	63	ND
TW22	12.3	0.018	0.016	912	232	0.07
TW23	1.4	0.013	ND	431	83	ND
TW24	4.6	0.007	0.016	641	227	ND
TW26	0.76	ND	0.006	536	179	ND
TW27	2.68	0.023	0.028	538	65	ND
TW30	3.61	ND	0.007	367	189	ND
TW33	0.24	ND	ND	43	23	0.30
TW36	11.9	0.053	0.078	385	101	ND
TW37	31.3	1.21	0.066	600	214	0.15
TW39	6.88	ND	0.076	306	87	ND
TW40	11.9	70.4	0.055	1770	1180	0.16
PW1	1.6	0.201	0.025	172	109	ND
PW2	0.79	0.027	0.009	100	58	ND
PW3	0.58	0.016	ND	84	45	ND
Calf Springs	8.85	ND	ND	316	64	ND
Mormon Springs	10.8	0.038	0.009	293	78	ND
SWG	7.52	ND	ND	291	56	ND
(EPA) Standards	2.4	0.01	0.01	250*	250*	-

*Recommended Concentrations for Standard Drinking Water

All other samples recorded concentrations less than drinking water standards.

ND = Not Detected (below detection limit)

5.0 HYDROGEOLOGICAL MODEL

5.1 General

This section describes the development of a conceptual hydrogeological model for the environment beneath the Soda Springs plant site. Although the plant site is complex hydrogeologically, an attempt has been made to define the most probable hydrogeological model based on the present data base. The model brings together the geological, geophysical, hydraulics, geochemical and potentiometric data presented in Section 4.0 of this report.

Analysis of the collected data has permitted the geological environment to be defined and a number of hydrostratigraphic zones identified. The overall conceptual hydrogeological model has been developed from this basis.

5.2 Geology

5.2.1 Stratigraphy

As discussed in Section 2.2, investigations prior to this study indicated the stratigraphy of the site to comprise surficial silty clay overlying Pleistocene basalts with interbedded cinder zones in turn overlying sandstones and limestones of the Salt Lake Formation. This sequence was in general confirmed by the geological reconnaissance and drilling program. The geological data collected from the present investigation is, however, considered much more reliable than that assembled from the previous limited well drilling. As such the following geological descriptions and interpretations are based on the data collected from the present investigation.

Based on drill cuttings and geophysical logging, five separate basalt flows have been shown to be present beneath the site. They have been designated Flow I, II, III, IV and V in ascending order, and are delineated on the basis of changes in lithology or abrupt changes in the natural gamma log response (Figures 5.1 to 5.4). Each successive flow is separated by weathered basalts or sedimentary interbeds. The basalt flows vary in thickness from 80 ft to less than 10 ft, and are separated by sedimentary interbeds or weathered zones from 23 ft thick to 1 ft thick. Based on these stratigraphic correlations, the basalt flows generally strike aproximately N60°W and dip at 2 degrees or less to the southwest..

5.2.2 Structural Geology

As discussed in Section 4.2.1.2, there are strong indications of a major normal fault traversing the plant site and the results of the drilling and geophysical logging have substantiated the presence of such a fault. In addition, a subparallel photolineament is present to the west of the normal fault. This feature could have three interpretations: a depositional/geomorphic feature such as a pressure ridge, a facies change such as the end of a basalt flow; or a structural geological feature such as a subsidiary fault. Any of the above geological features could explain the noted geological and hydrogeological conditions. However, based on Golder Associates' experience in similar geological environments and in particular at the plant site, we believe this feature to be a subsidiary fault subparallel to the main identified fault. This feature will be referred to as the subsidiary fault throughout the remainder of the text.

Figure 5.1 is a geological cross-section located parallel to the southern boundary of the plant site (see Plate 1). Lithologic and natural gamma correlations indicate west side down normal vertical displacement of about 20 ft on a fault striking between test wells TW11 and TW21. A further displacement is suggested between test wells TW9 and

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Section D-D

TW35, based on a distinct increase in offset of natural gamma and lithologic horizons between TW9 and TW35, compared to the offset between TW35 and TW21. (The possibility of a fault at this location was recognized during the aerial photography assessment (Section 4.2.2)). The offset of lithologic and geophysical horizons between TW21 and TW35 is in the order of 3 to 5 ft, giving a slope of less than 0.8 degrees. The offset of the same marker horizons between TW9 and TW35 is around 14 ft, yielding a slope of about 1.5 degrees. Therefore, it is likely that a fault (the subsidiary fault referred to above) lies between TW9 and TW35. However, this would not preclude another fault of very small displacement located between TW35 and TW21.

From the drilling results, vertical, west side down, normal displacement along the major fault appears to increase to the northwest, typical of a hinge fault. This agrees well with the topographic expression of the fault scarp. It also appears that displacement across the subsidiary fault mirrors that along the hinge fault; decreasing southwards. Both the hinge fault and the subsidairy fault appear to die out south of the plant site. Figure 5.2 is a geological cross-section across the central portion of the site from test well TW23 to test well TW32 (see Plate 1). Net vertical displacement between test wells TW23 and TW25 is about 80 ft.

Although distinctive stratigraphic and geological horizons are traceable over much of the plant site, faulting has caused vertical displacement of these horizons. As a consequence, it appears that permeable cinder zones and weathered basalt horizons may be offset against less permeable unweathered basalt. This results in discontinuous cinder zones over the plant site area. This phenomena is particularly well displayed in Figures 5.1 and 5.2, where the cinder zone above the γ 2 horizon appears to be truncated to the east by the main fault and to the west by the subsidiary fault.

The literature survey indicated that Threemile Knoll appeared to be an upfaulted block or horst structure. No evidence for the presence of faults south of Threemile Knoll was found during the drilling program. The basalt, however, thins considerably approaching the knoll.

The Paris Thrust Fault was not seen in the field reconnaissance or drilling program but was not anticipated based on the depths drilled.

5.3 Hydrostratigraphy

The geological sequence to a depth of about 250 ft beneath the plant site can be divided into four hydrostratigraphic zones. Each zone comprises several hydrogeological units which are defined on the basis of geology, hydraulic properties, potentiometric data and aqueous chemistry. These hydrostratigraphic zones have been identified by Golder Associates as follows:

- Surficial Deposit Zone,
- Upper Basalt Zone,
- Lower Basalt Zone and
- Salt Lake Zone.

Table 5.1 summarizes the major characteristics of each hydrostratigraphic zone.

5.3.1 Surficial Deposit Zone

This zone is composed of a sand and gravel aquifer which is both overlain and underlain by lower permeability silty clays. This zone is only found in the northeast and east-central plant site areas. The sand and gravel aquifer is about 10 ft in thickness. Airlift testing indicated the sands and gravels to be relatively permeable; however, no conventional permeability testing was carried out. Based on permeabil-

TABLE 5.1 CHARACTERISTICS OF HYDROSTRATIGRAPHIC ZONES

HYDRO-STRATIGRAPHIC ZONE	GEOLOGY	HYDRAULIC PARAMETERS	HYDRAULICS RESPONSE	POTENTIOMETRIC DATA	AQUEOUS GEOCHEMISTRY	WELL COMPLETED/ SPRINGS
SURFICIAL DEPOSIT	Quaternary alluvium sands, gravels silts, clays, < 40 ft. thick; overly basalt.	No testing. sands/gravels - aquifers silts, clays - aquitards Estimated k for sands and gravels = 10^3 ft.^{2}/day/ft.	Unknown.	Downward flow potential to underlying basalts.	<u>Fresh Water:</u> TDS < 600 mg/l Ca/Mg > 1 Dominant $CaHCO_3$ NO_3 > 5 mg/l Neutral pH, oxidising.	TW14
UPPER BASALT	Upper 100 ft. of basalts. Flows IV and V. Two-three basalt interbed zones (cinders, sands gravels, silts) 1-20 ft. thick and unweathered basalts 3-80 ft. thick.	Interbed zones - aquifers k = 100 - 10,000 ft.^{2}/day/ft. Basalts - "aquitards" horizontal k estimated < 100 ft.^{2}/day/ft. vertical k > 3 x 10^{-5} ft.^{2}/day/ft. Ss = 10^{-7} ft.$^{-1}$	Hydraulic communication between test wells completed in this zone at a well nest site.	No measurable potentiometric head difference between test wells completed at different depths at a well nest site in this zone apart from in south-west plant site area where upward component of hydraulic gradient between test wells at well nest site.	Fresh to slightly brackish water (apart from soda water in north west and southwest plant site corners). <u>Fresh To Slightly Brackish Water:</u> TDS 800 - 5,000 Mg/l, Ca/Mg > 1 Dominant Ca HCO_3 or $CaSO_4$ NO_3 > 5 mg/l, F > 0.5 mg/l Neutral pH, oxidising. (Soda water see Lower Basalt Zone.)	TW2*, TW6, TW7[a], TW8[a], TW10[a], TW12, TW15, TW16, TW17, TW19, TW20, TW22, TW24, TW26, TW27, TW29[a], TW30, TW31, TW33, TW36, TW37, TW38, TW39, TW40, PW1*, PW2*, PW3* Nelson, Lewis, SWC, SWC S.W. Spring[a], Dock[a], Rooper[a], Mormon, Calf.
LOWER BASALT	100 ft. to at least 250 ft. depth. Three to four basalt interbed zones (weathered basalts) < 10 ft. thick and unweathered basalt up to 50 ft. thick. Flows I, II, and III.	Interbed zones - "aquifers" k < 1 ft^2/day/ft. Ss = 10^{-7} ft.$^{-1}$ Basalts vertical k greater than 3 x 10^{-2} ft.^{2}/day/ft.	No hydraulic communication between test wells completed in both lower and upper basalt at well nest site.	Upward component of hydraulic gradient between individual test wells in Lower Basalt Zone in S.W. plant site. Upward or downward component of hydraulic gradient between Lower and Upper zone wells at well nest site in rest of plant site.	Soda water (apart from east central south-east and west central plant site areas where waters are fresh or slightly, brackish). <u>Soda Water:</u> TDS > 1,000 mg/l, Mg/Ca > 1 Dominant Mg HCO_3 NO_3 < 1 mg/l, Fe > 1 mg/l, pH 5.8 to 6.5, weakly oxidising (Fresh water see Upper Basalt Zone.)	TW3, TW4, TW5[-b], TW9, TW11[b], TW18, TW21, TW23, TW25, TW28, TW32[b], TW34, TW35.
SALT LAKE	Tertiary silty conglomerate > 25 ft. thick underlies basalts.	No testing. Estimated k < 1 ft.^{2}/day/ft.	Unknown.	Upward flow potential to overlying basalts.	<u>Fresh Water:</u> TDS < 600 mg/l Ca/Mg > 1 NO_3 > 5 mg/l Neutral pH, oxidising.	TW13

Notes: k - hydraulic conductivity
Ss - Specific storage

TDS - Total Dissolved Solids
Ca - Calcium, Mg - Magnesium
HCO_3 - Bicarbonate,
SO_4 - Sulfate
NO_3 - Nitrate, F - Fluoride,
Fe - iron

* These wells are open over their full depth; however, water quality resembles Upper Basalt Zone.

a - Soda Water Wells or Springs.
b - Fresh to slightly brackish water.

ity testing in similar material, the hydraulic conductivity of the sand and gravel aquifer is considered to be on the order of 10^3 ft^2/day/ft. Only test well TW14 is completed in this aquifer, and thus flow direction and hydraulic gradient cannot be determined. Geochemically, the water is fresh and similar to that of the underlying Upper Basalt Zone (Section 5.3.2).

No hydraulic or geochemical data are available for the overlying and underlying silty clay aquitards.

5.3.2 Upper Basalt Zone

This zone is composed of several basalt interbed aquifers and apparent basalt aquitards. The Upper Basalt Zone is found in most places beneath the plant site to a depth of about 100 ft below ground surface. In the northeast plant site area, the Upper Basalt Zone thins considerably (less than 30 ft) as the basalt laps onto Threemile Knoll. In general, there are two and at some locations three interbed aquifers made up of cinders and/or weathered basalts. These aquifers are separated by 2 basalt flows (Flow IV and Flow V).

The interbed aquifers (weathered basalts, cinders, sands and gravels) range in thickness from about 1 to 20 ft. thick. Permeability testing of these materials indicates a hydraulic conductivity ranging from about 100 to 10,000 ft^2/day/ft (Figure 4.3). The basalt "aquitards" consist of unweathered basalt ranging in thickness from 3 to 80 ft. The basalts mapped on the surface showed extensive vertical and horizontal jointing (Section 4.2.1.1). The vertical jointing is probably fairly extensive at depth due to the columnar nature of the basalts. The horizontal jointing visible at the surface however maybe a surficial weathering feature and is probably absent at depth.

Columnar jointing would impart a relatively high vertical hydraulic conductivity to the basalts. Analysis of the TW20 pump test data indicates a vertical hydraulic conductivity for the Upper Basalt of greater than about 5 x 10^{-5} ft^2/day/ft (Section 4.5.3). Analysis based on earth tide responses for the Lower Basalt Zone suggests a vertical hydraulic conductivity of greater than 3 x $10^{-2}ft^2$/day/ft and a low specific storage (10^{-7} ft^{-1}) (Section 4.7.2).

The horizontal hydraulic conductivity of the unweathered basalt has not been determined since no test wells were completed in these materials. However, Golder Associates' experience in similar basaltic environments suggests that the hydraulic conductivity of the unweathered basalt is probably relatively high although less than that of the interbed zones by possibly an order of magnitude or more. Ground water flow would thus be preferentially through the more permeable interbed zones.

Although there are apparent differences in the hydraulic parameters for the different geological units within the Upper Basalt Zone:

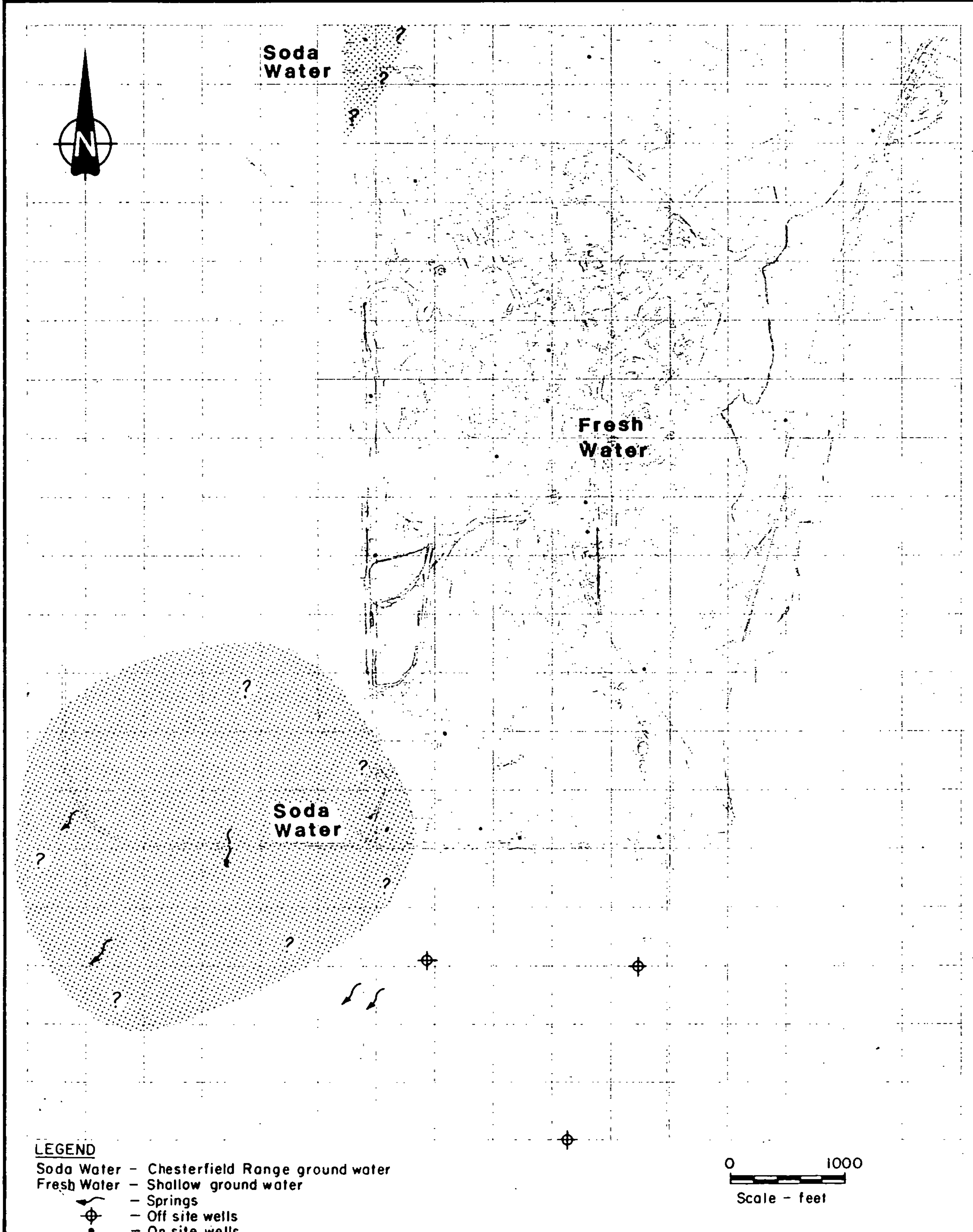
- o the results of the airlift development/testing (showing hydraulic communication between most test wells at any one well nest completed at different depths within this Zone)
- o the potentiometric data (showing no measurable difference in the hydraulic heads between test wells completed at different depths at a well nest site in this Zone) and
- o similar aqueous geochemistries between test wells and this zone,

suggests that the basalt interbed zones and unweathered basalts of Flows IV and V act regionally as a single hydrostratigraphic zone.

The ground water in the Upper Basalt Zone is generally fresh to slightly brackish (Table 5.1) with the exception of test wells TW7, TW8 and TW10 and Hooper, Dock and Southwest Springs in the southwest plant site area and TW29 in the northwest plant site area (Figure 5.5.). Ground water sampled from the Upper Basalt Zone in the southwest and

UPPER BASALT ZONE
GROUND WATER TYPES

Figure 5.5



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northwest plant site areas is sodic, (Section 4.6.4) characteristic of the Lower Basalt Zone water (Table 5.1). Data from test well TW4 is suspect however due to apparent construction difficulties and the results of hydraulics testing (Section 4.5.2) which indicate that it may be in direct hydraulic communication with test well TW3.

Within the plant site area, the Upper Basalt Zone is recharged by infiltration of precipitation, downward movement from the Surficial Deposit Zone (where present), underflow of ground water from the north, northeast and east of the plant site and some component of ground water from the underlying Lower Basalt Zone over parts of the site (Figure 4.4. shows areas of upward hydraulic gradient). Discharge of ground water is by means of flow to the south and downward leakage in the central plant site area to the underlying Lower Basalt Zone (see Figure 4.4.) and by pumping from plant production wells PW1, PW2 and PW3.

5.3.3 Lower Basalt Zone

The Lower Basalt Zone is composed of several basalt interbed aquifers and basalt aquitards (Basalt Flows I, II and III). The Zone is found in most places beneath the plant site underlying the Upper Basalt Zone to a depth of at least 250 ft (deepest well). This Zone thins and is found at shallower depths or may not be present in the area of test wells TW13, TW14 and TW15, where the basalts apparently lap onto the flanks of Threemile Knoll. In general, there are three aquifers, and at some locations four, less than 10 ft in thickness. These aquifers are separated by unweathered basalts.

The physical characteristics of the drill cuttings and drill penetration rate of the basalt aquitards suggests that these basalts are similar in nature to those of the Upper Basalt Zone. However, the analysis based on earth tide responses suggest that the vertical hydraulic conductivity of these basalts is low. In addition, the potentiometric data show measurable differences in hydraulic head at most well nest sites between test wells completed in the Upper Basalt and Lower Basalt Zones. Lastly, the results of the airlift development/testing show no hydraulic communication in most wells at any one well nest completed in both the Upper and Lower Basalt Zone; although indicative of a low vertical hydraulic conductivity, the short duration of the airlift development/testing does not allow for a conclusive assessment. Golder Associates considers it likely that there is a decrease in vertical hydraulic conductivity with depth. Thus, the basalts in this Lower Basalt Zone are considered to act as regional aquitards. Quantification of aquitard parameters, other than thickness, is not possible with the present data.

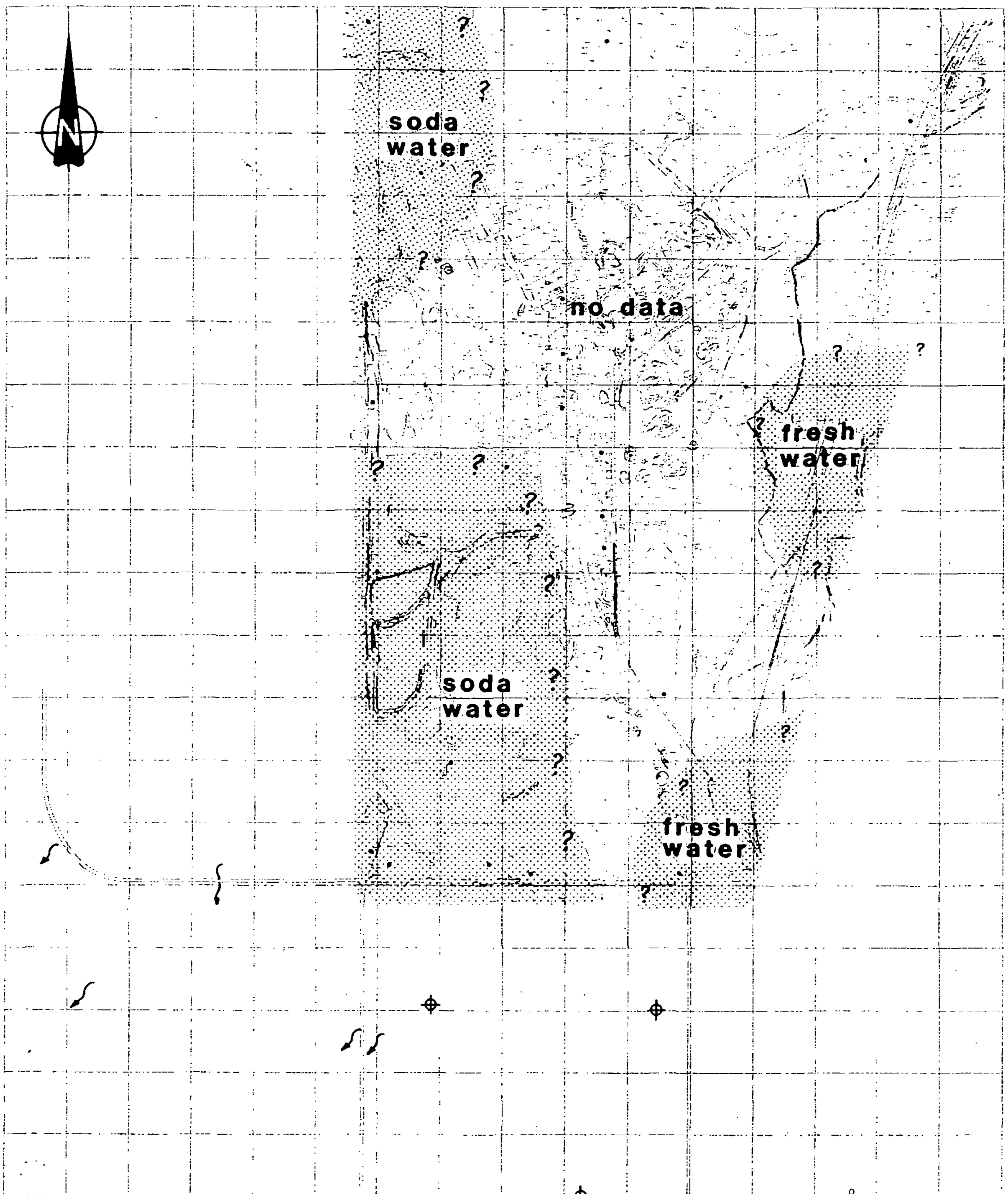
The basalt interbed aquifers are composed mostly of weathered basalts with some cinders. The average hydraulic conductivity value for these aquifers, based on tests run on test wells TW5, TW9 and TW25, is less than 1 ft^2/day/ft. A value for storativity could not be assessed with the present data since no two test wells were completed in the same zone at a particular well nest site (Section 4.5.2).

Most of the test wells in the Lower Basalt Zone in the western portion of the plant site contain soda water, characteristic of the Chesterfield Range System (Table 5.1) while those in the eastern portion of the plant site contain fresh water (Figure 5.6). Over much of the central plant site area, there are no test wells completed in the Lower Basalt Zone and hence the water type is unknown.

The Lower Basalt Zone is recharged by downward leakage from the Upper Basalt Zone in the central and eastern portions of the plant site and from upward leakage from the basalts or Salt Lake Zone underlying

LOWER BASALT ZONE
GROUND WATER TYPES

Figure 5.6



LEGEND
Soda Water - Chesterfield Range ground water.
Fresh Water - Shallow ground water.
- Springs
- Off site wells
- On site wells

the Lower Basalt Zone. The Lower Basalt is probably also recharged by underflow from upgradient (north of the plant site). The Zone discharges southwards via underflow and upwards to the Upper Basalt Zone over the southern portions of the plant site. In addition, the pumping of plant production wells PW1, PW2 and PW3 abstracts ground water from the Lower Basalt Zone.

5.3.4 Salt Lake Zone

This zone, found only in test well TW13 in the north east corner of the plant site, is considered to underlie the basaltic zones and is thought to exist everywhere beneath the plant site area. However, with the exception of the area around Threemile Knoll, this zone is apparently at greater depth than investigated during this study.

Visual examination of the drill cuttings from TW13 compare with the observed surface exposures of the Salt Lake Formation (a stratified silty conglomerate). Description of average aquifer parameters is not possible based on the limited data from test well TW13. However, based on a comparison with similar soils we consider the hydraulic conductivity of the silty conglomerate to be less than 1 ft^2/day/ft. The hydrochemistry from TW13 is similar to that of the fresh water of the Shallow Ground Water System type (Table 5.1), however it is considered likely that the hydrochemistry of the Salt Lake Zone underlying the basalts in the central and southern plant site areas is different from that seen in TW13.

5.4 Conceptual Hydrogeological Model

A conceptual hydrogeological model of the environment beneath the plant site combines an interpretation of geology, hydrogeology and geochemistry. Four hydrostratigraphic zones have been defined in the previous subsection, however as a result of the limited data available for the Surficial Deposit and Salt Lake Zones the development of a conceptual model for these zones is not possible. The majority of data assembled during this investigation is from the Upper and Lower Basalt Zones. The conceptual hydrogeological model developed in this section concentrates on these two zones which have the greatest significance for the movement of ions from the plant operations through the ground water system.

5.4.1 Upper Basalt Zone

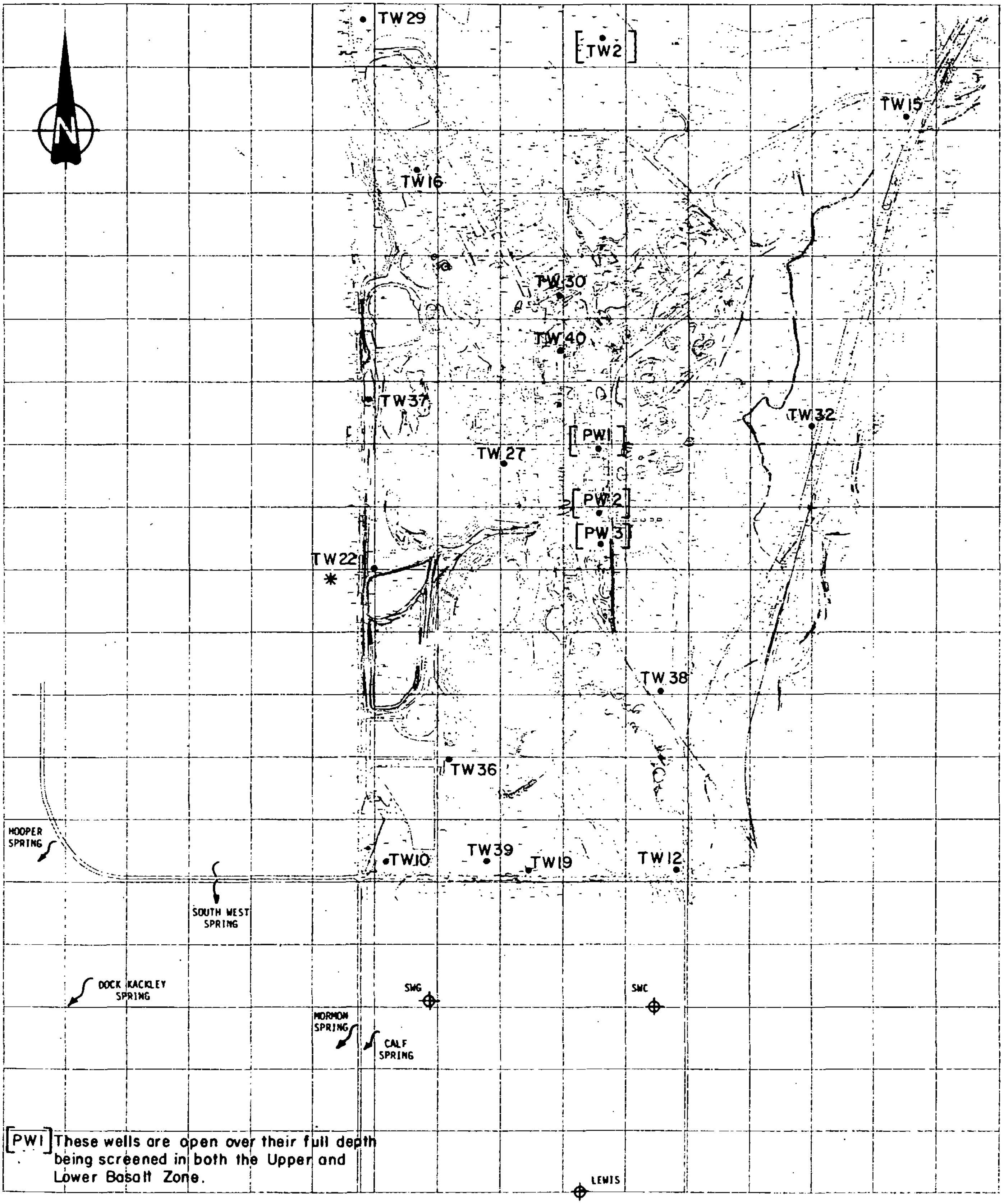
A base map showing the locations of wells and springs in the Upper Basalt Zone is shown on Figure 5.7. Where two or more test wells are completed within the Upper Basalt Zone at a particular location only the shallowest well (with the exception of TW24) is identified on Figure 5.7, due to the similarities in potentiometric data and aqueous geochemistry between test wells completed at different depths in this zone. Test well TW24 was affected by grout following construction; data from test well TW22 is therefore used instead.

Potentiometric data for these test wells is presented in Table 4.13. Equipotentials and ground water flow lines based on these data can be drawn in several ways depending on the interpretation of geology, hydraulics and hydrochemistry. Setting aside these constraints, a visually interpolated contouring of these data is presented on Figure 5.8. This figure indicates that in general, ground water flow is southwards or southwestwards. The plant production wells create a localized cone of depression in the center of the plant site.

The ground water flow directions developed in this conceptual model must also be consistent with the aqueous geochemistry within the Upper

UPPER BASALT ZONE BASE MAP

Figure 5.7



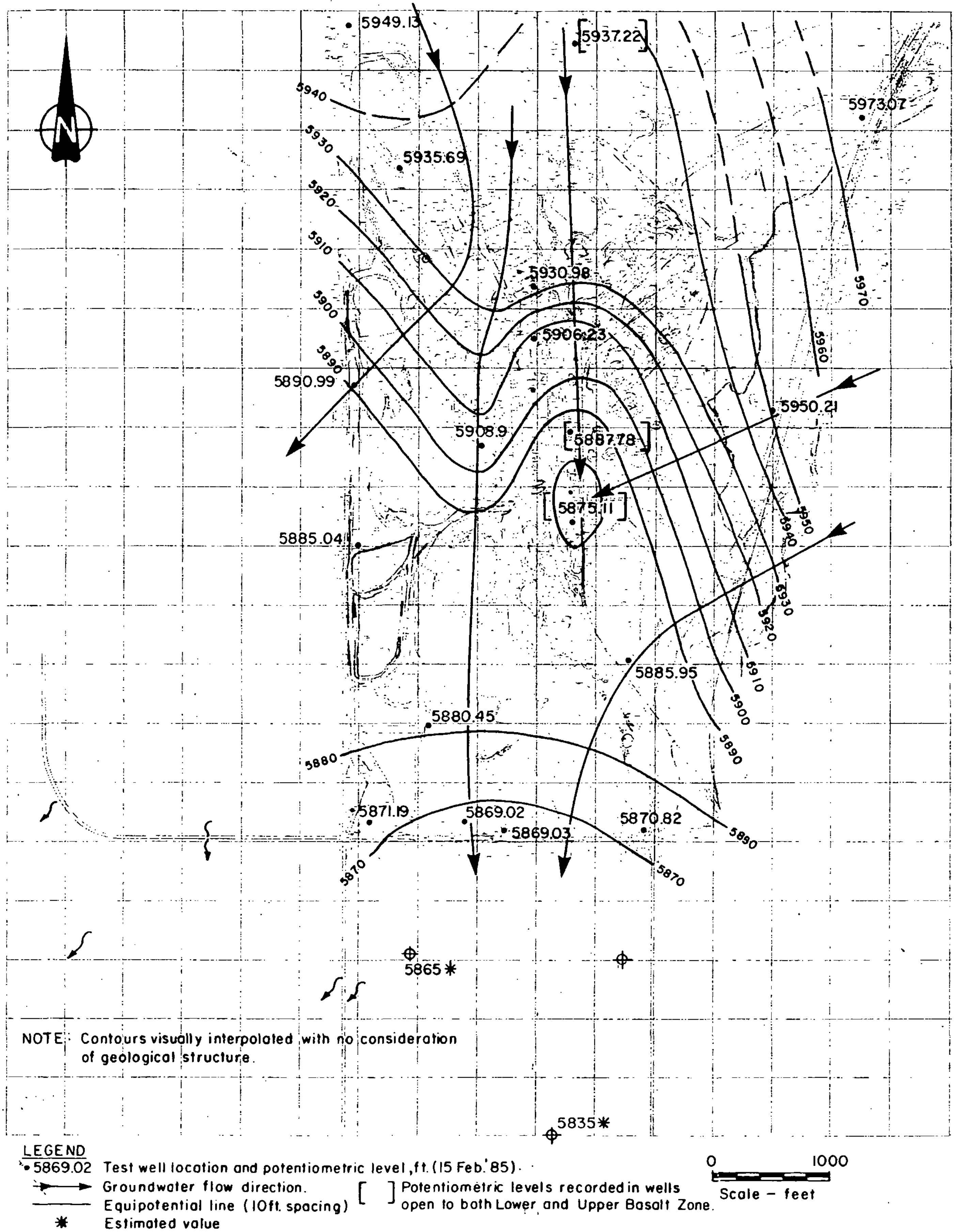
[PWI] These wells are open over their full depth being screened in both the Upper and Lower Basalt Zone.

* TW 24 is the shallowest well at this location. Potentiometric or geochemical data from this well have not been used since the well is affected by grout.

0 1000
Scale – feet

UPPER BASALT ZONE GROUND WATER FLOW DIRECTIONS (NO STRUCTURAL INFLUENCE)

Figure 5.8



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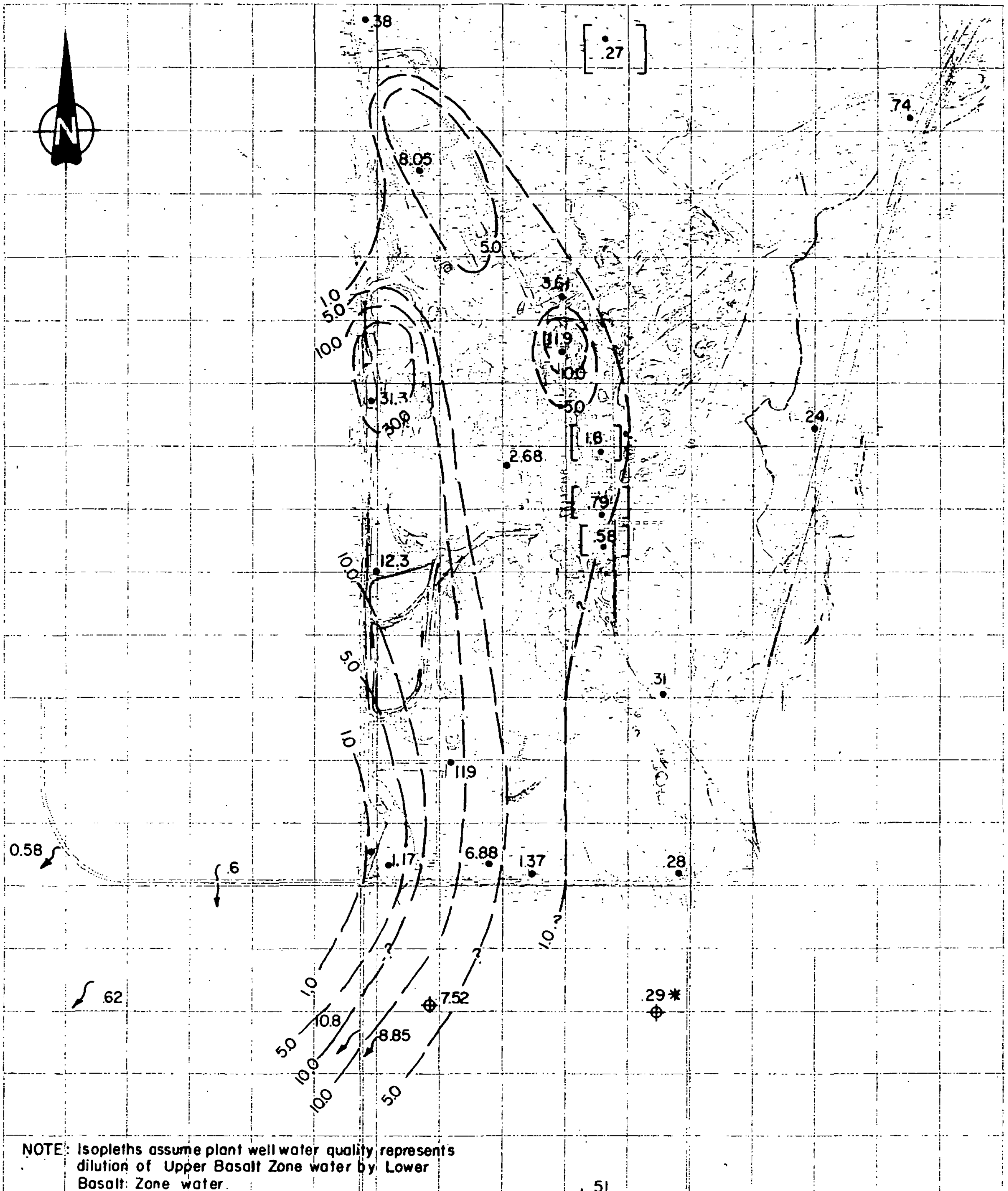
Basalt Zone. An examination of the water quality data (Section 4.6) indicates that there are a number of ions within the local ground water system above background levels. These ions are fluoride, cadmium, selenium, sulfate, chloride and vanadium. The spatial distribution of these ions within the ground water system should (irrespective of structure) reflect the overall direction(s) of ground water flow within this zone. Figures 5.9, 5.10, 5.11, 5.12, 5.13 and 5.14 present the distributions of fluoride, cadmium, selenium, sulfate, chloride and vanadium respectively based on visually interpolated contouring of the ion concentrations from the February/March 1985 sampling period. It should be noted that test well TW2 and plant production wells PW1, PW2 and PW3 are open over the Upper and Lower Basalt Zones. Water quality from these wells represents a mixing of water from both zones. The results of the drilling (Section 4.3.2) indicate that most ground water is produced from the cinder zones within 100 ft of the water table (Upper Basalt). It is therefore probable, that the plant production wells make the majority of their water from the Upper Basalt Zone but also receive some ground water from the Lower Basalt Zone. The Lower Basalt Zone ground waters are apparently lower in fluoride, cadmium, selenium, sulfate, chloride and vanadium concentrations than the Upper Basalt waters. Mixing of the two waters in the well bore will tend to produce a water that is a somewhat diluted mixture of the true Upper Basalt Zone ground waters. The ion isopleths in the following figures have been drawn taking this potential mixing into account.

The fluoride distribution (Figure 5.9) shows a relatively narrow plume (approximately 1,000 ft wide) of fluoride-enriched ground water > 5 mg/l) extending southwards in the western plant site area south from the area of the old underflow solids ponds. This plume appears to deviate to the southwest south of the plant site.

UPPER BASALT ZONE FLUORIDE (NO STRUCTURAL INFLUENCE)

Figure 5.9



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

• 6.88 Fluoride concentration (mg/l) Feb./Mar. 1985

10 — — — Fluoride isopleth (mg/l)

* Nov. 1984 concentration

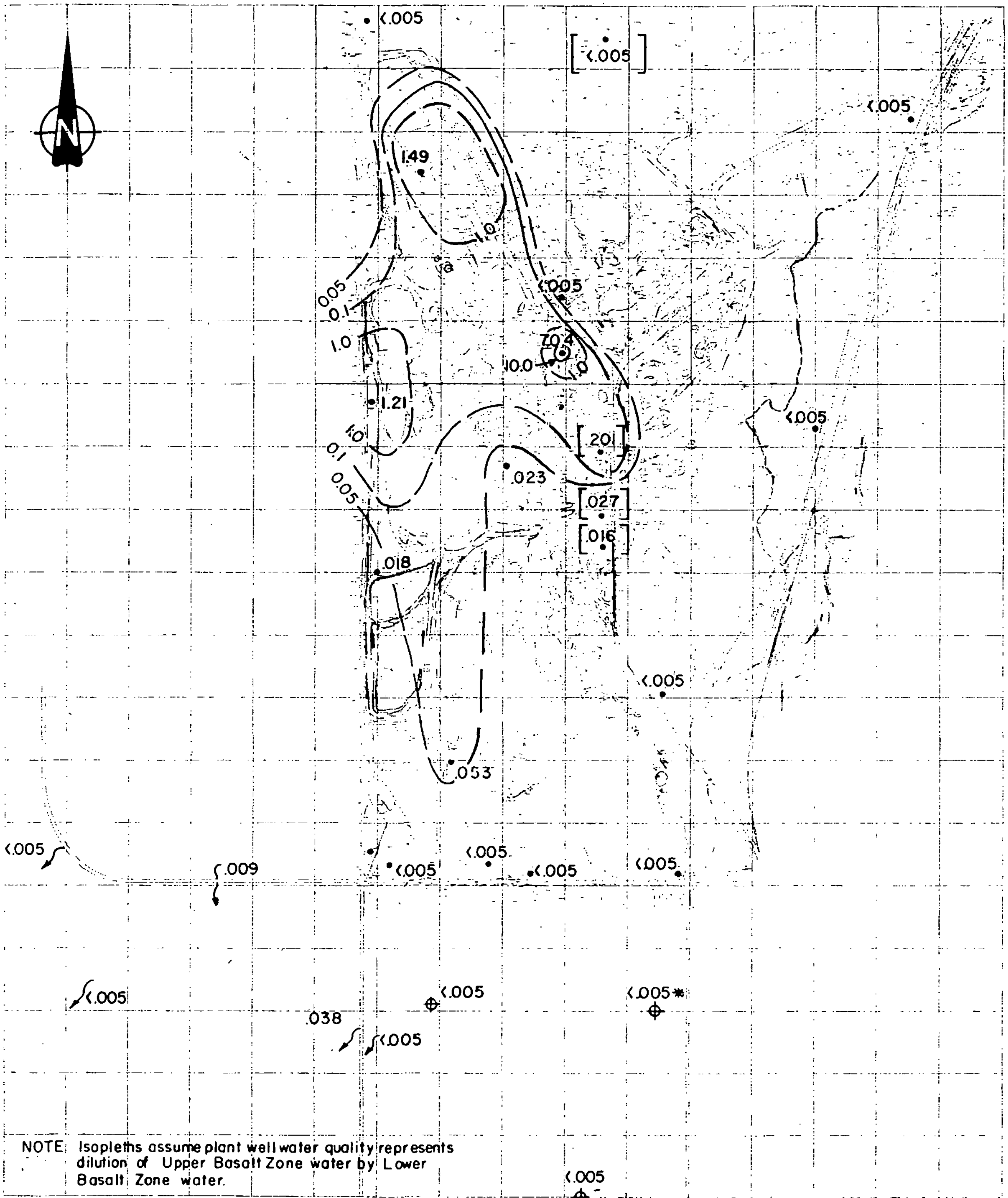
[ ] Wells open to both Lower and Upper Basalt Zone.

0 1000

Scale - feet

UPPER BASALT ZONE
CADMIUM
(NO STRUCTURAL INFLUENCE)

Figure 5.10



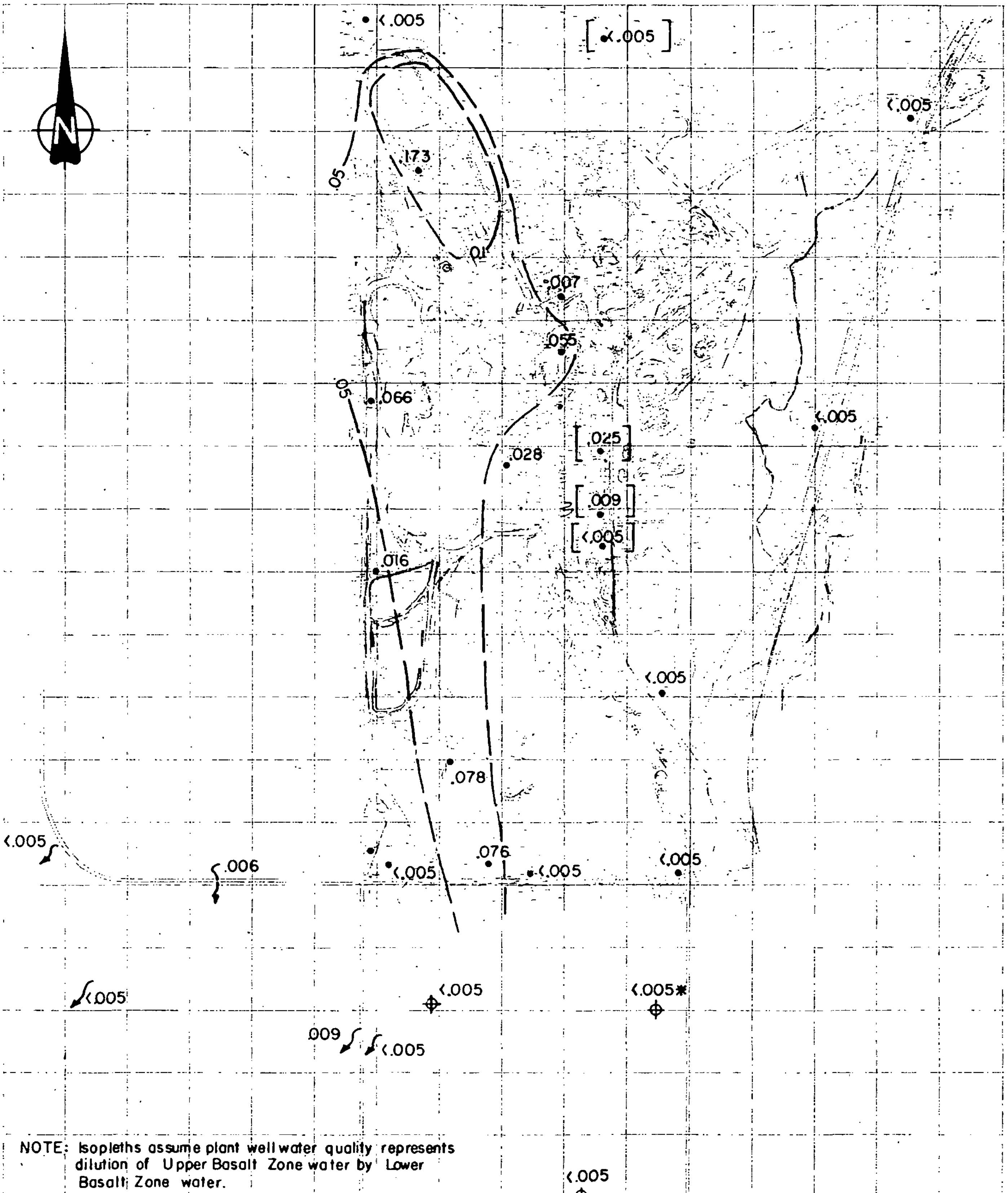
NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

- •.053 Cadmium concentration (mg/l) Feb./Mar. 1985
- .01 — — — Cadmium isopleth (mg/l)
- * Nov. 1984 concentration.
- [ ] Wells open to both Lower and Upper Basalt Zone

0 1000
Scale - feet

UPPER BASALT ZONE SELENIUM (NO STRUCTURAL INFLUENCE)	Figure 5.11



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

•.076 Selenium concentration (mg/l) Feb./Mar. 1985.

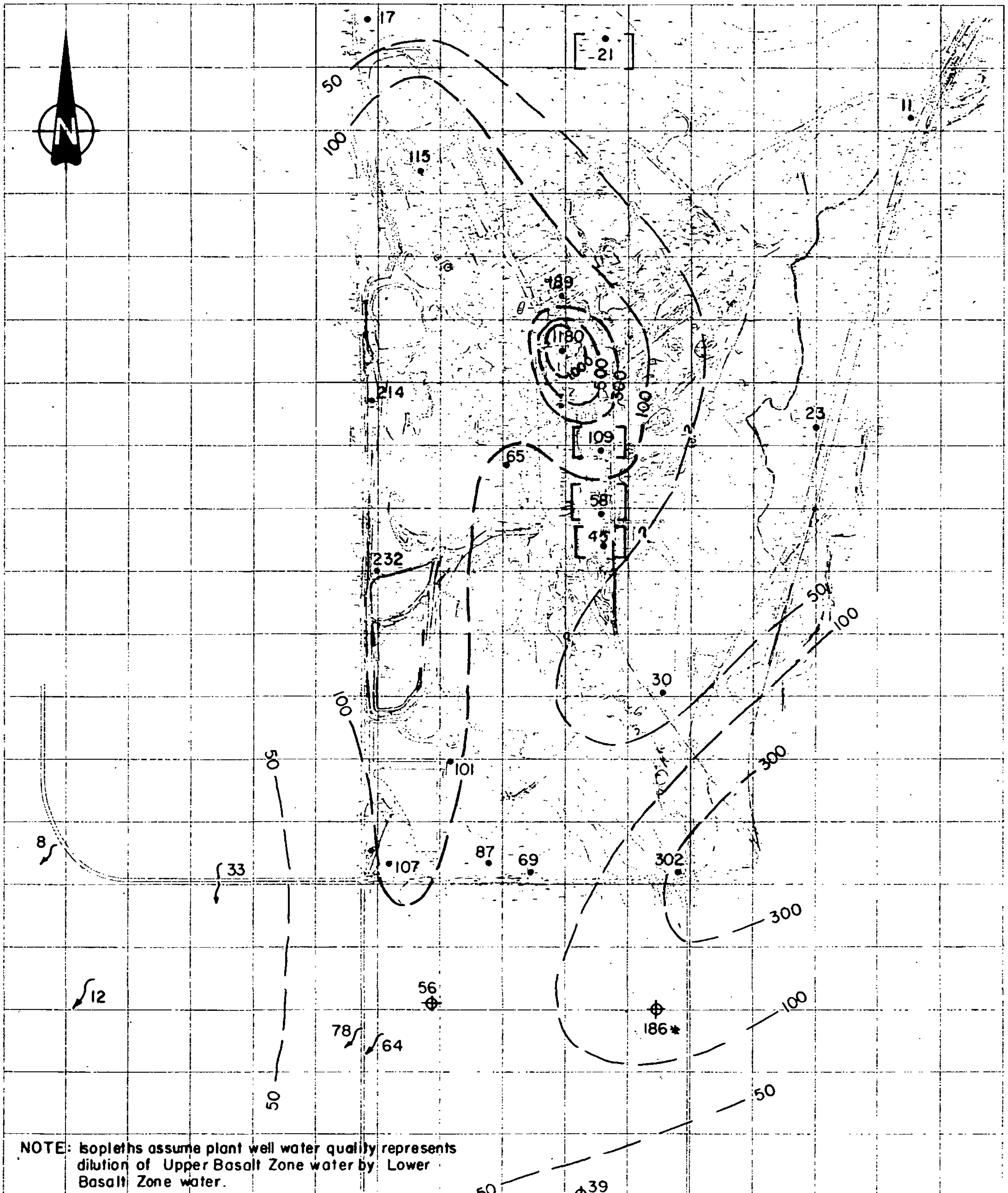
.05 — — — Selenium isopleth (mg/l)

[ ] Wells open to both Lower and Upper Basalt Zone.

* Nov. 1984 concentration.

UPPER BASALT ZONE
CHLORIDE
(NO STRUCTURAL INFLUENCE)

Figure 5.12



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

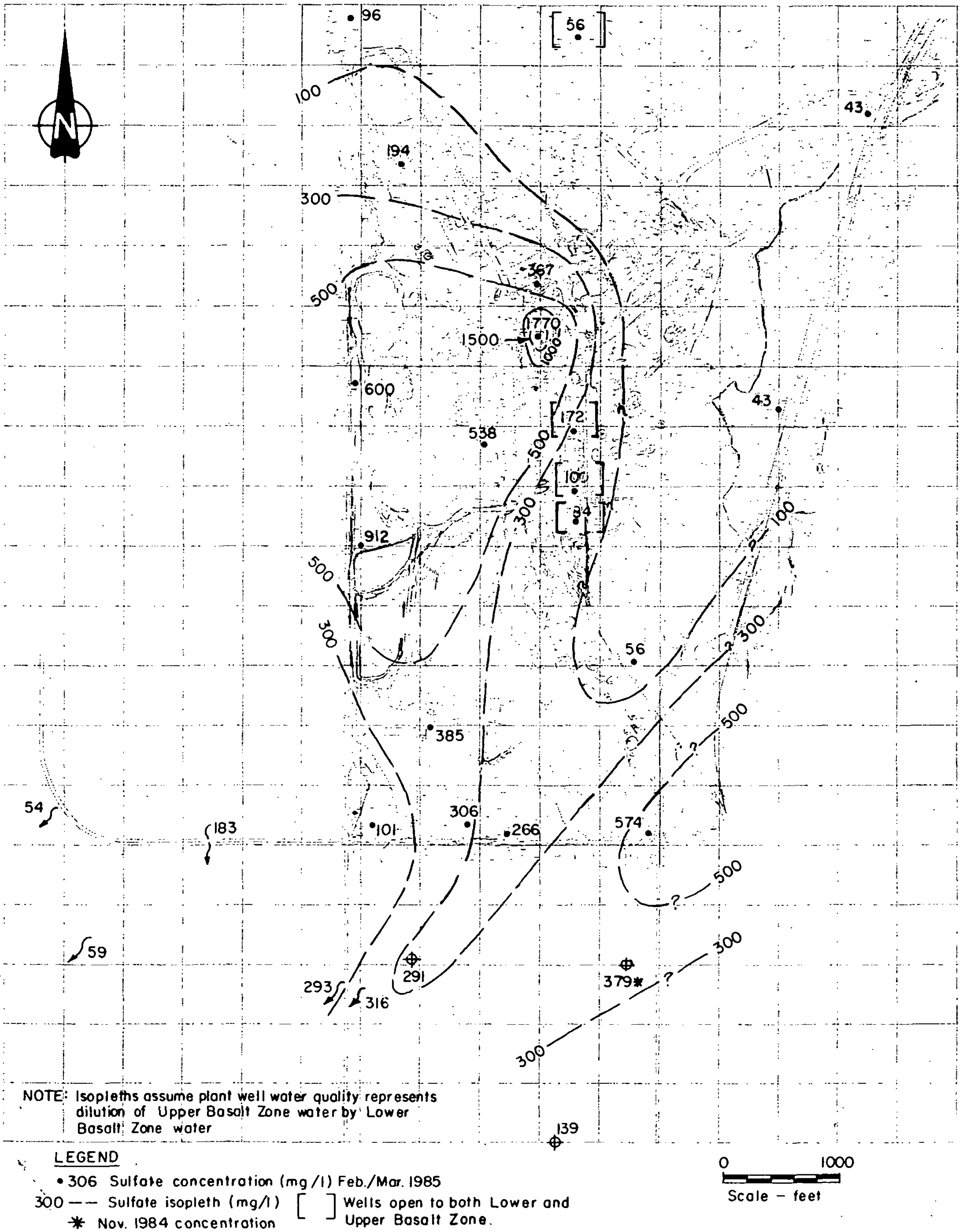
LEGEND

- • 107 Chloride concentration (mg/l) Feb/Mar. 1985
- 100 — — Chloride isopleth (mg/l)
- ✳ Nov. 1984 concentration.
- [ ] Wells open to both Lower and Upper Basalt Zone.

0 1000
Scale – feet

UPPER BASALT ZONE
SULFATE
(NO STRUCTURAL INFLUENCE)

Figure 5.13



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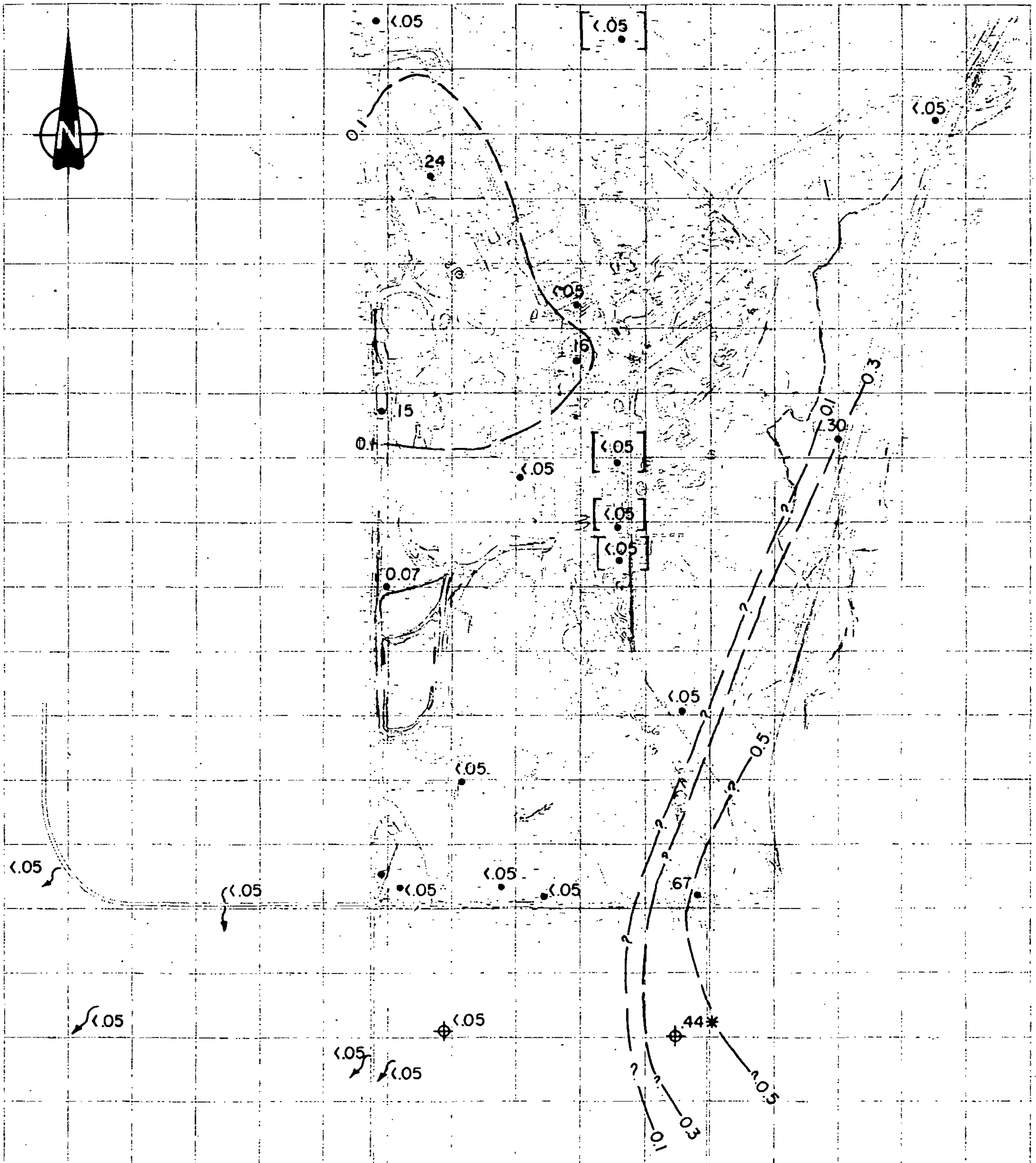
UPPER BASALT ZONE
VANADIUM
(NO STRUCTURAL INFLUENCE)

Figure 5.14



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water

LEGEND

• .15 Vanadium concentration (mg/l) Feb/Mar. 1985

.30—— Vanadium isopleth (mg/l)

* Nov. 1984 concentration.

[ ] Wells open to both Lower and Upper Basalt Zone.

0 1000

Scale – feet

Golder Associates

The chloride and sulfate distributions (Figure 5.12 and 5.13) are similar in shape to the fluoride distribution on the western side of the plant site however to the south east of the plant site there is an area of relatively high (300-500 mg/l) chloride and sulfate concentrations. The area of elevated chloride and sulfate concentrations is apparently oriented in a northeast-southwesterly direction.

The spatial distributions of cadmium (Figure 5.10) and selenium (Figure 5.11) concentrations generally have the same overall shape as that of fluoride while the vanadium concentrations (Figure 5.14) somewhat resemble the sulfate and chloride distributions to the east and south east of the plant site.

The spatial distributions (irrespective of structure) of all of the above ions are generally inconsistent with the ground water flow directions for the western side of the property as presented on Figure 5.8. The fluoride, cadmium, selenium, sulfate and chloride distributions indicate a generally southerly flow of ground water on the western side of the property south of the old underflow solids ponds. Figure 5.8 indicates that a southwesterly flow would be expected in this area.

To the east and south of the plant site, it appears that the distribution of sulfate, chloride and vanadium could be partially explained by the ground water flow directions presented on Figure 5.8.

In order to present a plausible conceptual hydrogeological model fully explaining the observed ion distributions, the model must also incorporate the expected hydraulics effects of the geological structure and local hydrogeological conditions (i.e. recharge/discharge areas).

Available geological data indicates that both the hinge fault and subsidiary fault appear to have thrown relatively permeable basalt interbed aquifers against less permeable (although still permeable) unweathered basalt zones (Figures 5.1, 5.2). The juxtaposition of less permeable basalts and permeable interbed zones across the faults combined with the possible development of some fault gouge, could make the faults act as "barriers" to ground water flow. Hydraulics data from the test well TW20 pump test and plant production well tests appear to corroborate this. It should be noted that although the term "barrier" is used when referring to the hydraulic effect of the faults it is probable that the faults are only partial barriers and that some ground water flow takes place across the fault planes or zones.

The throw across the hinge fault appears to decrease southeastwards from about 80 ft in the central plant site area to about 20 ft across the southern plant site boundary. Surface reconnaissance shows the fault scarp to disappear south of the plant site possibly indicative of a disappearance of the fault. The topographic fault scarp is visible for at least 1,500 ft south of the plant site and it is likely that the hinge fault acts as a "barrier" to groundwater flow along this length but further south the fault may have very little effect on the hydrogeological conditions. Similarly, the throw across the subsidiary fault may also diminish southwards. The topographic expression of this fault is not visible either on the plant site (due to the presence of ponds) or immediately south of the plant site.

The hydrogeological conditions (the presence of springs and the upward component of hydraulic gradient) indicates a ground water discharge zone west of the plant site and in the southwest corner of the plant site. Soda water appears to be upwelling from the Lower Basalt Zone to discharge at or near the ground surface. This ground water discharge zone could act as a hydraulic partial "barrier" boundary in the south western plant site area and effect the flow lines in a similiar manner to the fault "barrier".

Figure 5.15 presents the potentiometric data from Table 4.13 contoured assuming that the major fault and the subsidiary fault or discharge area in the southwest plant site area act as partial "barriers" to ground water flow. Comparison of Figure 5.15 and Figures 5.9 to 5.14 indicates that this conceptual flow model is generally able to explain the observed distributions of fluoride, cadmium, selenium, sulfate and chloride and vanadium over the plant site area.

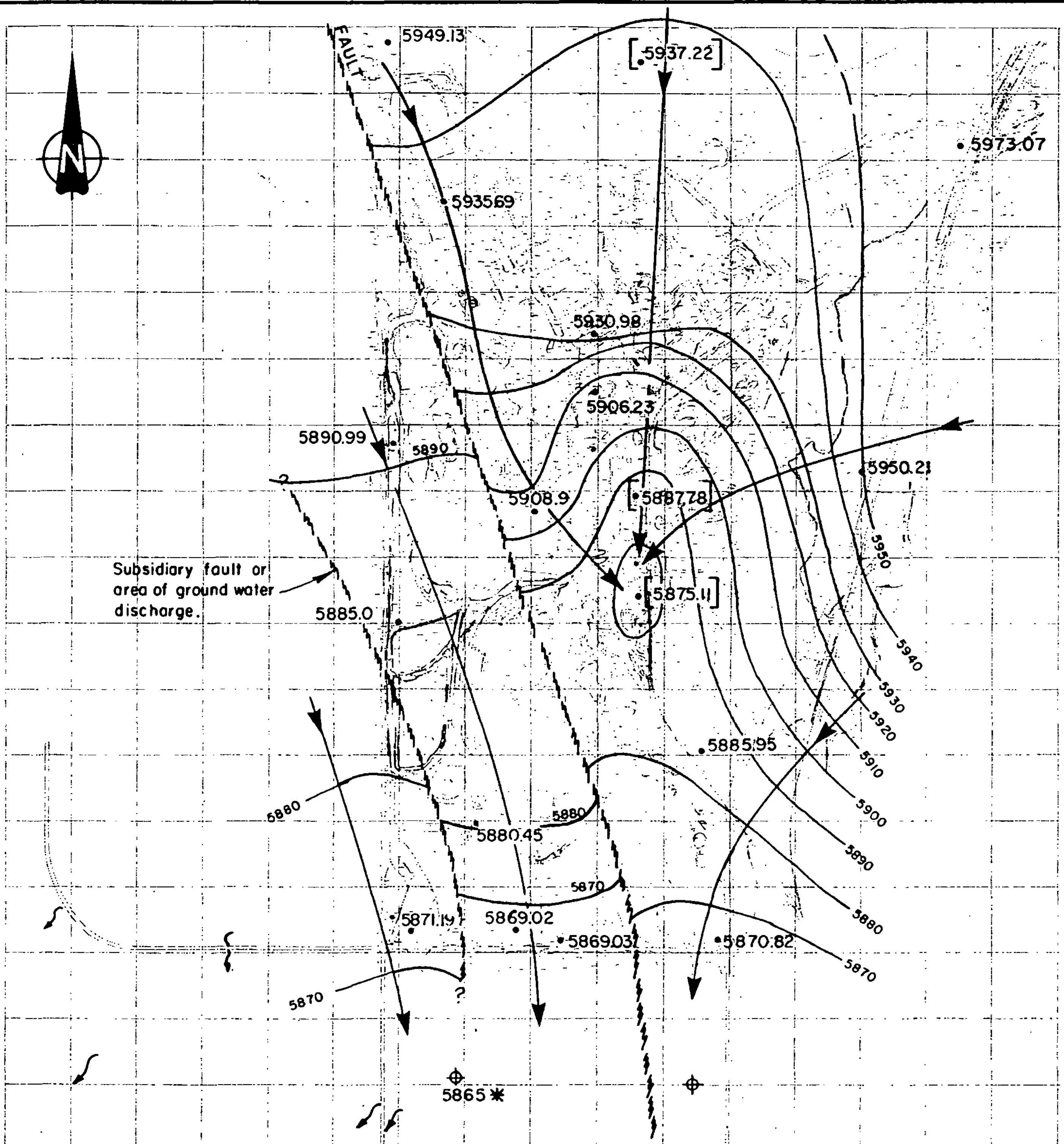
To the west of the hinge fault, the general direction of ground water flow is to the southeast at a gradient of about 0.006. There appear to be two ground water flow systems west of the hinge fault: one, bounded to the east by the hinge fault and to the west by the subsidiary fault or hydraulic barrier, containing fresh water to slightly brackish water with elevated fluoride, cadmium, selenium, sulfate and chloride; and a second flow system to the west of the subsidiary fault/hydraulic barrier containing soda water with background concentrations of fluoride, cadmium, selenium, sulfate and chloride.

To the east of the hinge fault, in the central plant site area, the pumping of the plant production wells creates a cone of depression intercepting much of the south to southeasterly flowing ground water. Ground water is also drawn in from the east to the pumping centers. The hydraulic gradient in this area is locally as steep as 0.05 (as determined from the equipotentials and flow lines on Figure 5.15). By creating a cone of depression the pumping wells appear to intercept the southeasterly migration of fluoride, cadmium, selenimum, chloride and sulfate from sources in the northwest quadrant of the plant site.

To the southeast of the plant production wells, the ground water flow direction is generally to the south under a gradient of about 0.02. This flow direction is generally inconsistent with the distributions of sulfate, chloride and vanadium in this area presented on Figures 5.12,

UPPER BASALT ZONE GROUND WATER FLOW DIRECTIONS (ASSUMING STRUCTURAL INFLUENCE)

Figure 5.15



NOTE: Main fault and subsidiary fault are assumed partial barriers to ground water.

LEGEND
- • 5869.02 Test well location and potentiometric level, ft. (15 Feb. '85)
- Groundwater flow direction.
- Equipotential line (10 ft. spacing)
- * Estimated value
- [ ] Wells open to both Lower and Upper Basalt Zone.

0 1000
Scale - feet

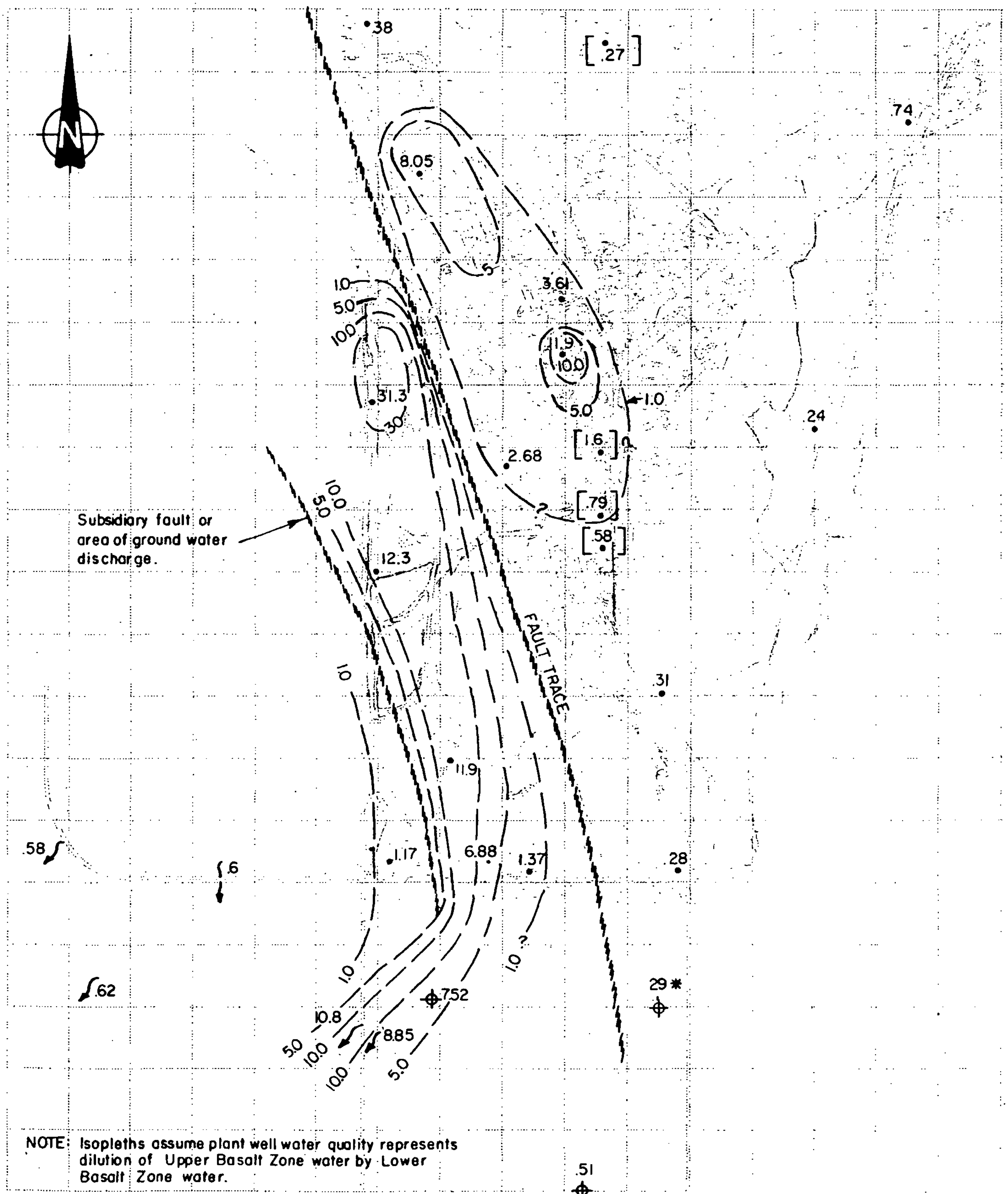
5.13 and 5.14. It is believed that the hinge fault acts as a "barrier" in this area and therefore, the distributions of these ions are probably orientated in a more southerly direction consistent with the overall direction of ground water flow rather than extending southwestwards as indicated on Figure 5.12, 5.13, 5.14.

For this conceptual flow model, it is probable that the actual distributions of fluoride, cadmium, selenium, sulfate, chloride and vanadium within the ground water system reflect the proposed flow directions. Figures 5.16 to 5.21 inclusive, present the distributions of these ions considering the conceptual flow model presented in Figure 5.15. It should be noted that the fluoride and sulfate distributions south of the southwest plant site corner appear to indicate that the subsidiary fault/ground water discharge area is not present in this area. However, since geological and hydrogeological data is limited south and west of the plant site, the exact reason for the distribution of fluoride and sulfate in this area cannot be identified. In addition, the chloride distributions (Figure 5.19) appear to indicate that the ground water quality in test well TW10 may be affected by seepage from the effluent stream or leakage from the effluent lagoon.

The average linear velocity is a function of the hydraulic gradient, hydraulic conductivity and the effective porosity of the zone. The effective porosity has not been determined explicitly by any of the field programs. Based on a visual examination of the drill cuttings, the total porosity of the interbeds could be as high as 50 per cent. However, the specific storage data suggest that the effective porosity, could be relatively low, say less than 10 per cent. Based on an estimated value of hydraulic conductivity of 2.5×10^3 $ft^2/day/ft$ (Section 4.5.4) and known hydraulic gradients, the ground water flow rates beneath the plant site could vary from about 150 ft/day on the western side of the hinge fault to about 1200 ft/day in the area north and east

UPPER BASALT ZONE
FLUORIDE
(STRUCTURAL INFLUENCE)

Figure 5.16



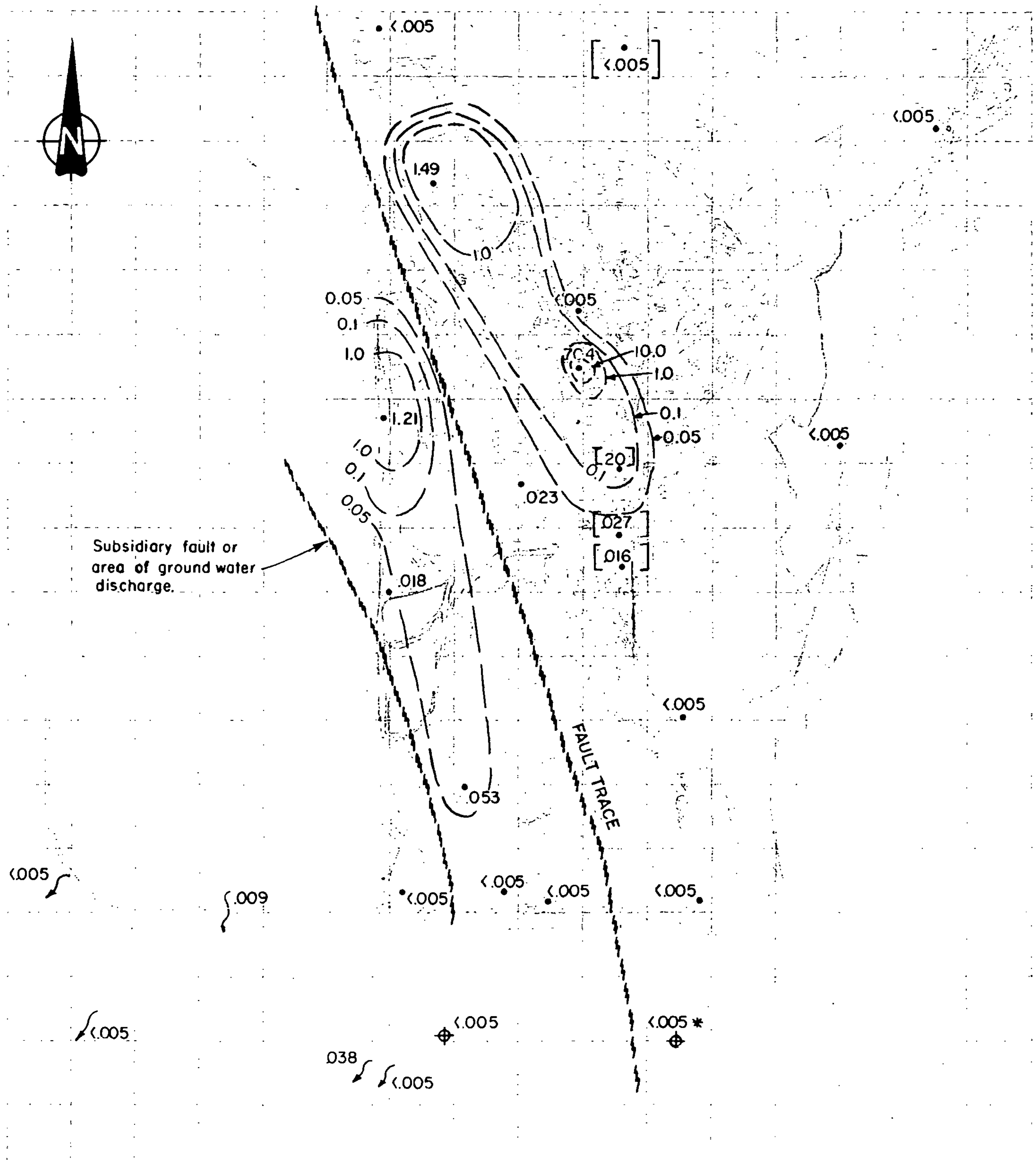
NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

- •6.88 Fluoride concentration (mg/l) Feb./Mar. 1985.
- 10 —— Fluoride isopleth (mg/l)
- * Nov. 1984 concentration.
- [ ] Wells open to both Lower and Upper Basalt Zone.

0 1000
Scale - feet

UPPER BASALT ZONE CADMIUM (STRUCTURAL INFLUENCE)	Figure 5.17



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

- •.053 Cadmium concentration (mg/l) Feb/Mar. 1985
- .01 — — Cadmium isopleth (mg/l)
- * Nov. 1984 concentration.
- [ ] Wells open to both Lower and Upper Basalt Zone.

0 1000
Scale – feet

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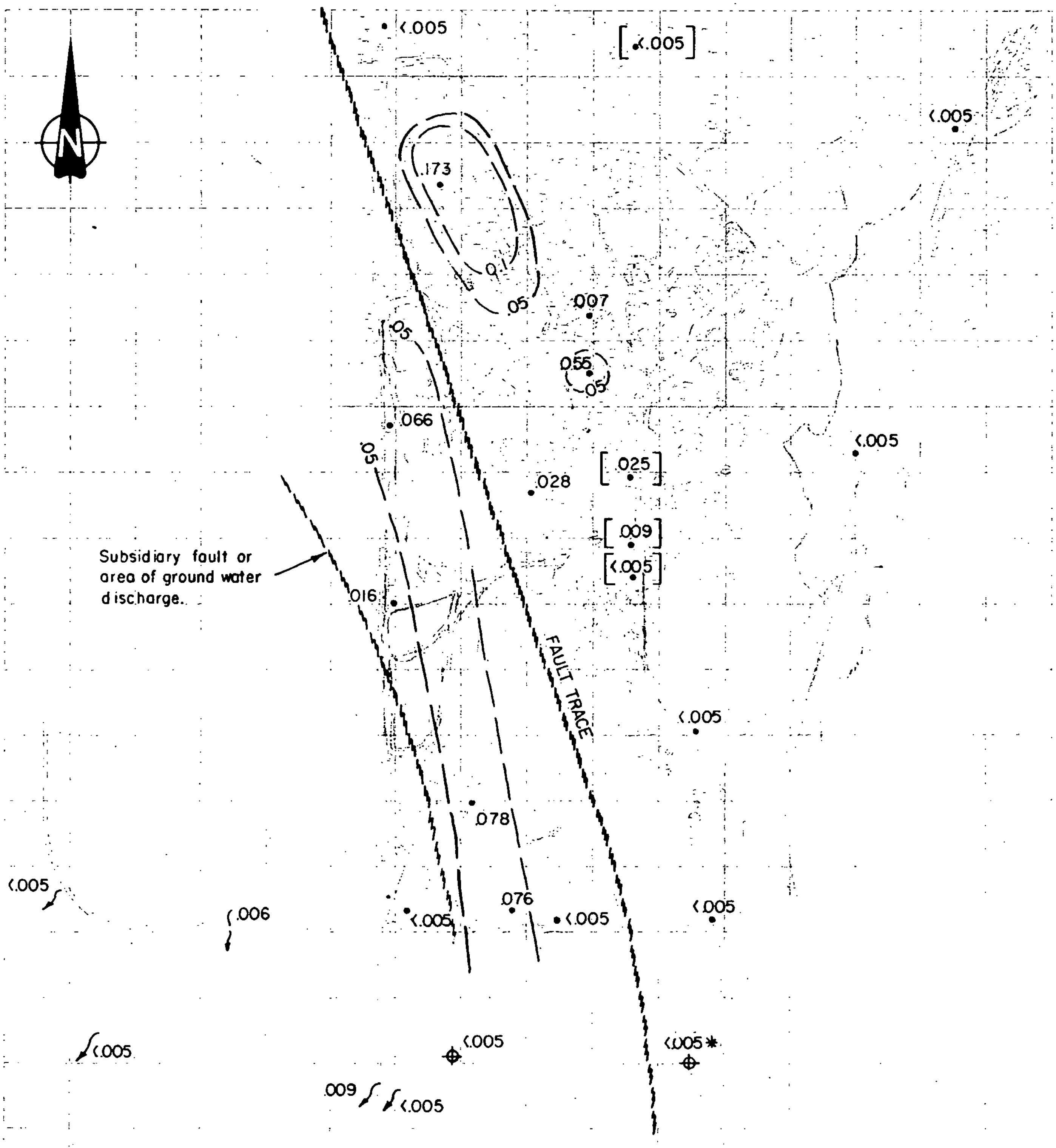
UPPER BASALT ZONE
SELENIUM
(STRUCTURAL INFLUENCE)

Figure 5.18



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

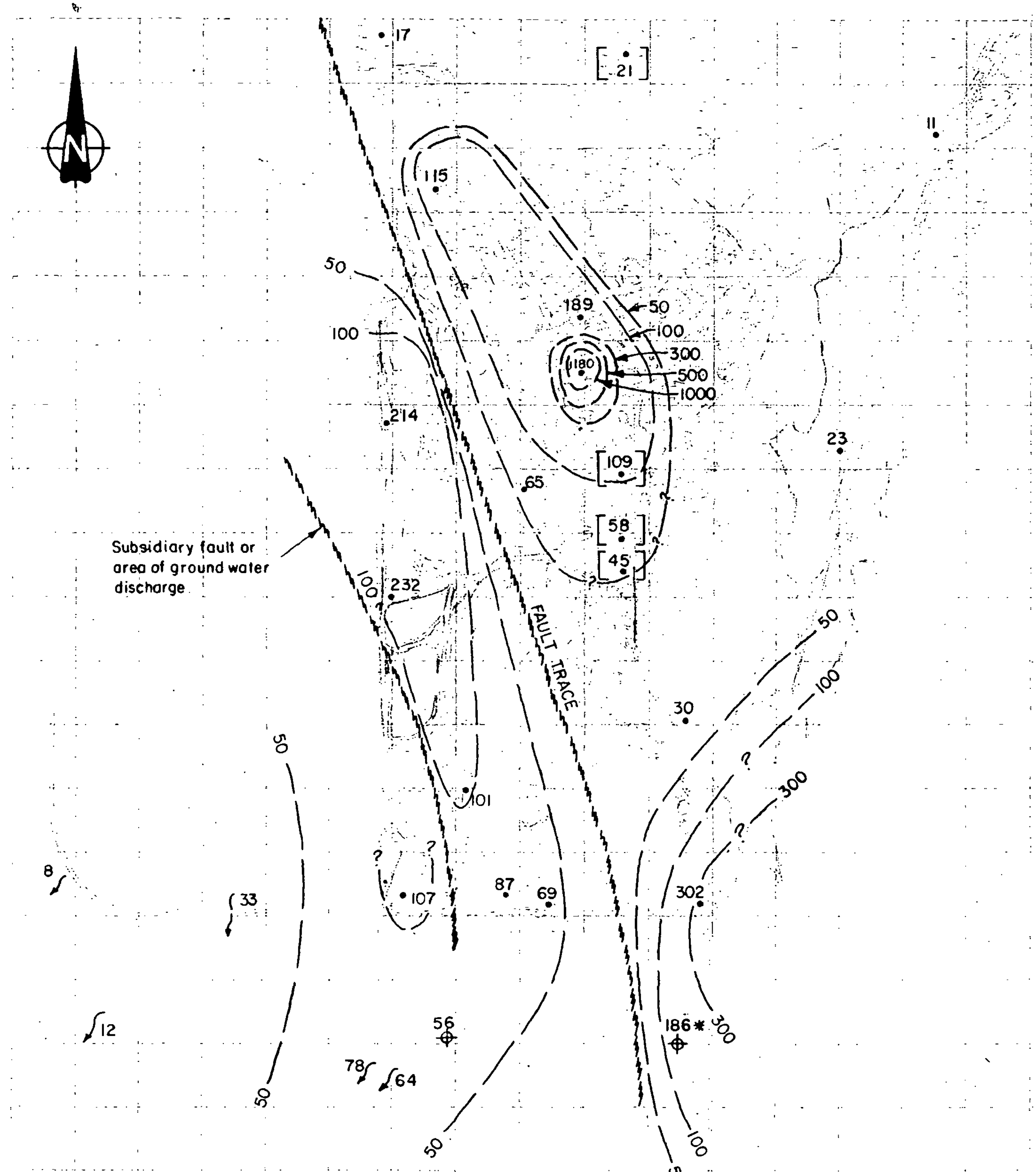
LEGEND

- • .076 Selenium concentration (mg/l) Feb./Mar. 1985.
- .05 — — Selenium isopleth (mg/l)
- [ ] Wells open to both Lower and Upper Basalt Zone.
- * Nov. 1984 concentration.

0 1000
Scale – feet

UPPER BASALT ZONE CHLORIDE (STRUCTURAL INFLUENCE)

Figure 5.19



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

• 107 Chloride concentration (mg/l) Feb/Mar. 1985.

100 — — Chloride isopleth (mg/l)

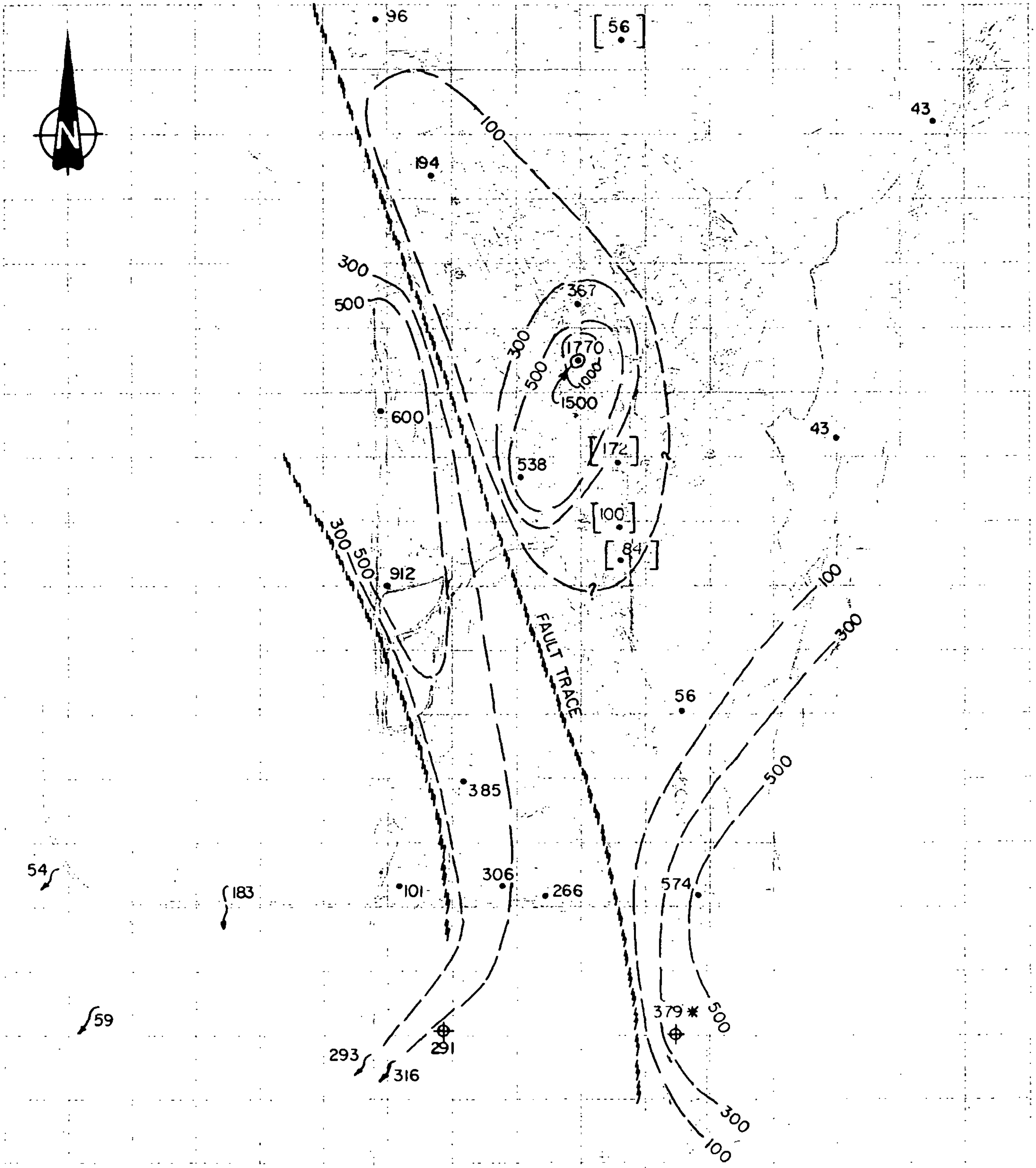
✳ Nov. 1984 concentration.

[ ] Wells open to both Lower and Upper Basalt Zone.

0 1000 Scale - feet

UPPER BASALT ZONE
SULFATE
(STRUCTURAL INFLUENCE)

Figure 5.20



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

• 306 Sulfate concentration (mg/l) Feb./Mar. 1985

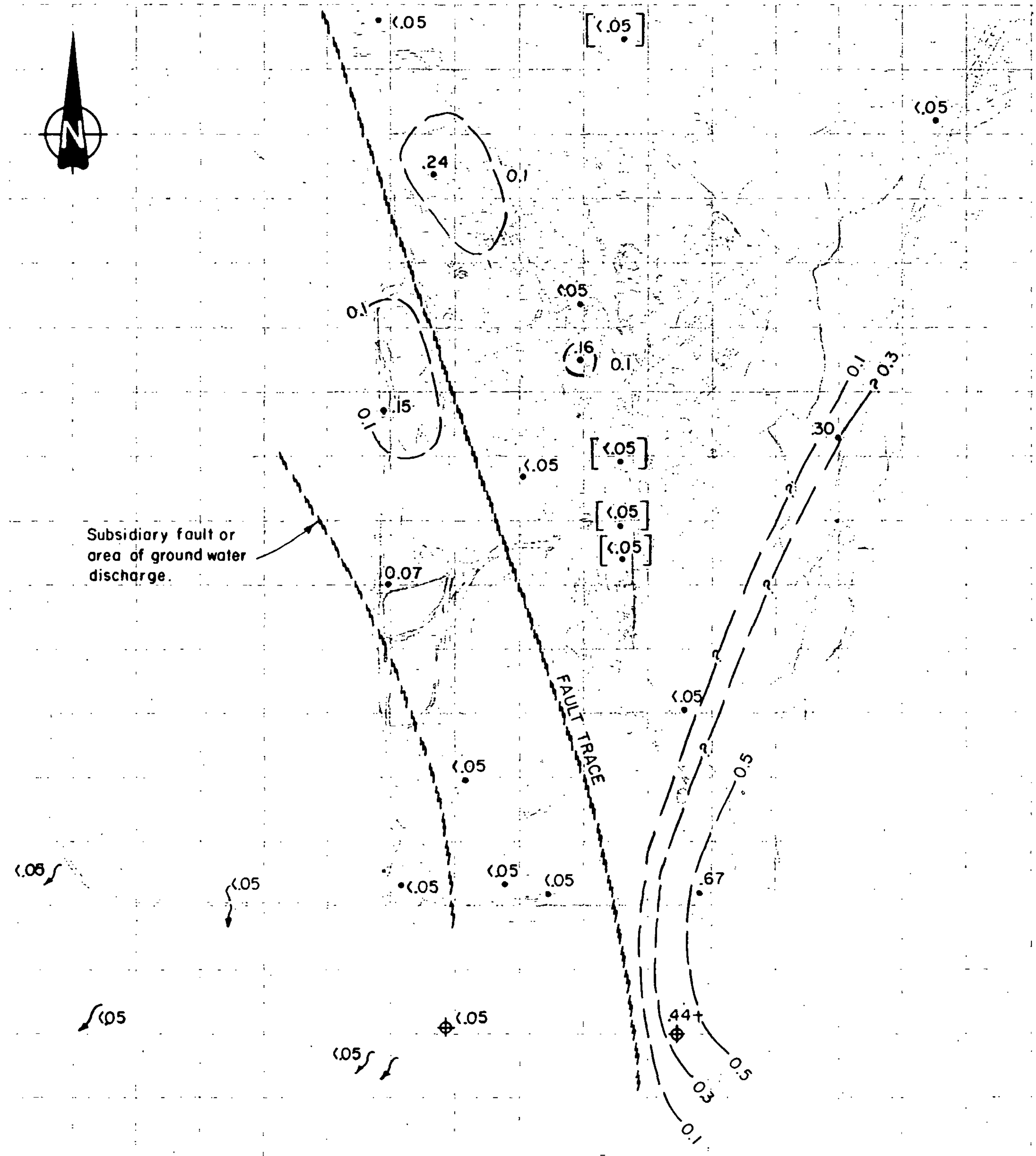
300 — — Sulfate isopleth (mg/l)

✳ Nov. 1984 concentration.

[ ] Wells open to both Lower and Upper Basalt Zone.

UPPER BASALT ZONE
VANADIUM
(STUCTURAL INFLUENCE)

Figure 5.21



NOTE: Isopleths assume plant well water quality represents dilution of Upper Basalt Zone water by Lower Basalt Zone water.

LEGEND

- • .15 Vanadium concentration (mg/l) Feb./Mar. 1985.
- .30 — — Vanadium isopleth (mg/l).
- ✳ Nov. 1984 concentration.
- [ ] Wells open to both Lower and Upper Basalt Zone.

0 1000
Scale - feet

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of the plant production wells. It is emphasized that the ground water flow rates presented above are estimates and it is more probable that a range of flow rates exist say from about 20-200 ft/day on the western side of the hinge fault and from 200 to 2000 ft/day in the central plant site area.

5.4.2 Lower Basalt Zone

Compared to the Upper Basalt Zone there is significantly less data available to develop a conceptual ground water flow model for the Lower Basalt Zone. However, having developed a conceptual flow model for the Upper Basalt Zone it is likely that a similar overall flow model (with some slight modifications) is applicable to the Lower Basalt Zone. Other models have been considered, but cannot be substantiated because of the limited data.

A base map showing the locations of most test wells completed in the Lower Basalt Zone is shown on Figure 5.22. Where more than one test well at any particular location is completed in the Zone, only the deepest test well is identified on the base map. Figure 5.23 contours the potentiometric data for the test wells shown on Figure 5.23, assuming that both the hinge fault and subsidiary fault or ground water discharge area are partial barriers to ground water flow and that the plant production wells create a cone of depression in the center of the plant site similar to that seen in Upper Basalt Zone. The overall direction of ground water flow is to the south under a hydraulic gradient ranging from 0.03 in the area to the north east of the plant production wells to about .006 in the south central portion of the plant site.

The distribution of fluoride, cadmium, selenium, sulfate, chloride and sulfate in the Lower Basalt Zone are shown on Figure 5.24 to 5.29

respectively. Geochemical data from test well TW25 is suspect since the well was affected by grout during completion. The water quality in this test well does not appear to have reached equilibrium with the local environment (see Stiff diagrams B-11 in Appendix B). In general, the distributions of fluoride and cadmium are fairly similar in shape to that of the Upper Basalt Zone indicative of similar flow directions. Some differences, particularly sulfate and chloride are apparent; however, this may be due to the limited data and potential interference caused by using data from TW25. It is concluded however, that with the available hydrogeological and geochemical data the ground water flow model presented in Figure 5.23 is generally representative of the conditions in the Lower Basalt Zone.

As indicated in Section 5.3.3, there is both downward leakage from the overlying Upper Basalt Zone into the Lower Basalt Zone and upward leakage from the Lower Basalt Zone into the Upper Basalt Zone. Based on the hydrogeological setting of the plant site (valley bottom) it is considered probable that prior to the installation of the plant production wells the area underlying the plant site was a regional ground water discharge area receiving flow from depth with an upward vertical gradient across the plant site. It appears that the installation and subsequent pumping of the plant production wells, which are open over their full depth and therefore draw water from both the transmissive Upper Basalt Zone and less transmissive Lower Basalt Zone, has probably disrupted the natural system reversing the regional hydraulic gradients close to the center of the plant site. Since the Lower Basalt Zone aquifers are less transmissive than the Upper Basalt aquifers, the pumping of the plant production wells has probably resulted in a greater drawdown in the Lower Zone aquifers when compared to the Upper Zone aquifers close to the plant production wells and thus reversed the pre-pumping upward flow component to a downward flow component. This hydraulic gradient reversal would induce the downward movement of ground water from the Upper Basalt Zone to the Lower Basalt Zone in the center of the plant site. The water would then flow inwards to the plant production wells where it is discharged from the system.

Assuming an effective porosity for the Lower Basalt Zone aquifers of between 1% and 0.1% (based on examination of the drill cuttings), a hydraulic conductivity of 1 ft^2/day/ft, and most probable hydraulic gradients (Figure 5.23), the average linear ground water velocity in the Lower Basalt Zone aquifers is estimated to range from 0.6 to 6 ft/day to the west of the hinge fault and from 3 to 30 ft/day in the area to the northeast of the plant production wells.

5.5 Hydrogeological Model Summary

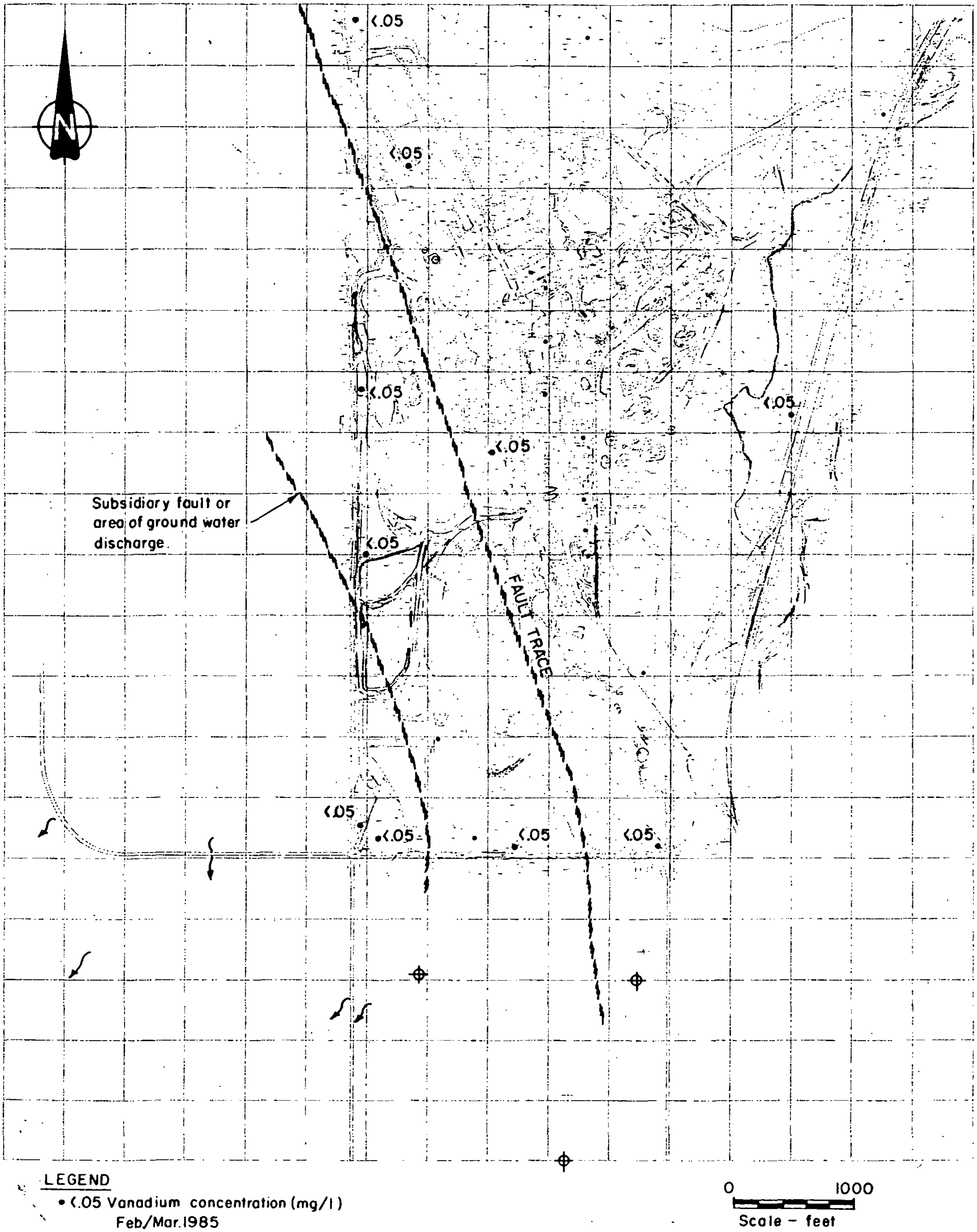
There are four hydrostratigraphic zones underlying the plant site: the Surfical Deposit Zone, the Upper Basalt Zone, the Lower Basalt Zone and the Salt Lake Zone. The Surfical Deposit Zone is only known to be present in the northwest quadrant of the plant site. The Salt Lake Zone was only identified in the northeast plant site area but is probably present at depth under the plant site underlying the Lower Basalt Zone.

Ground water flow in the Upper Basalt Zone is influenced by faulting and/or regional hydrogeological conditions and pumping of the plant production wells. Both the hinge fault and the postulated subsidiary fault which strike northwest-southeast, appear to act as "barriers" to groundwater flow. The presence of a regional ground water discharge area south west of the plant site appears to have a similar effect as a "barrier" boundary. The ground water flow direction is generally to the south or southeast parallelling the geological structure. Estimated ground water flow rates range from about 20 to 2000 ft/day in this zone. The pumping of the plant production wells creates a cone of depression in the central plant site area intercepting ground water flowing from the north, northeast and east of the plant site. The Upper Basalt Zone is recharged by precipitation, underflow from the north and east and leakage from the underlying Basalt Zone over the southern and northern parts of the plant site. Discharge from the Upper Basalt Zone is by pumping of the plant production wells and also southwards via underflow. Plant production well pumping also appears to have induced downward leakage from the Upper Basalt Zone into the Lower Basalt Zone over the central portions of the plant site. This ground water may then be drawn towards the pumping wells in the Lower Basalt Zone and discharged from the system. Figure 5.30 is a summary two-dimensional conceptual flow model for the Upper Basalt Zone based on the potentiometric and geochemical data.

The available hydrogeological and geochemical data indicates that groundwater flow in the Lower Basalt Zone is also influenced by faulting and/or a regional ground water discharge zone and the pumping of the plant production wells. The faults and discharge zone act as "barriers" to ground water flow. The ground water flow direction is similar to that of the Upper Basalt Zone; southeastwards over much of the southern plant site area and southwestwards over the northeast plant site quadrant. Estimated ground water flow rates in this zone range from 0.6 to 30 ft/day. The Lower Basalt Zone is recharged by leakage from the underlying Salt Lake Zone or deeper lying basalts and by leakage from the overlying Upper Basalt Zone in the central plant site area. The pumping of the plant production wells appears to be responsible for the downward leakage from the Upper Basalt Zone to the Lower Basalt Zone in the central plant site area. It appears that the leakage from the Upper Basalt Zone may eventually flow towards the plant production wells in the Lower Basalt Zone and be discharged from the system. The Lower Basalt Zone also discharges southwards via underflow and upwards to the Upper Basalt Zone over the southern portions of the plant site. Figure 5.31 is a summary two-dimensional conceptual flow model for the Lower Basalt Zone based on the potentiometric and geochemical data.

LOWER BASALT ZONE
VANADIUM
(STRUCTURAL INFLUENCE)

Figure 5.20



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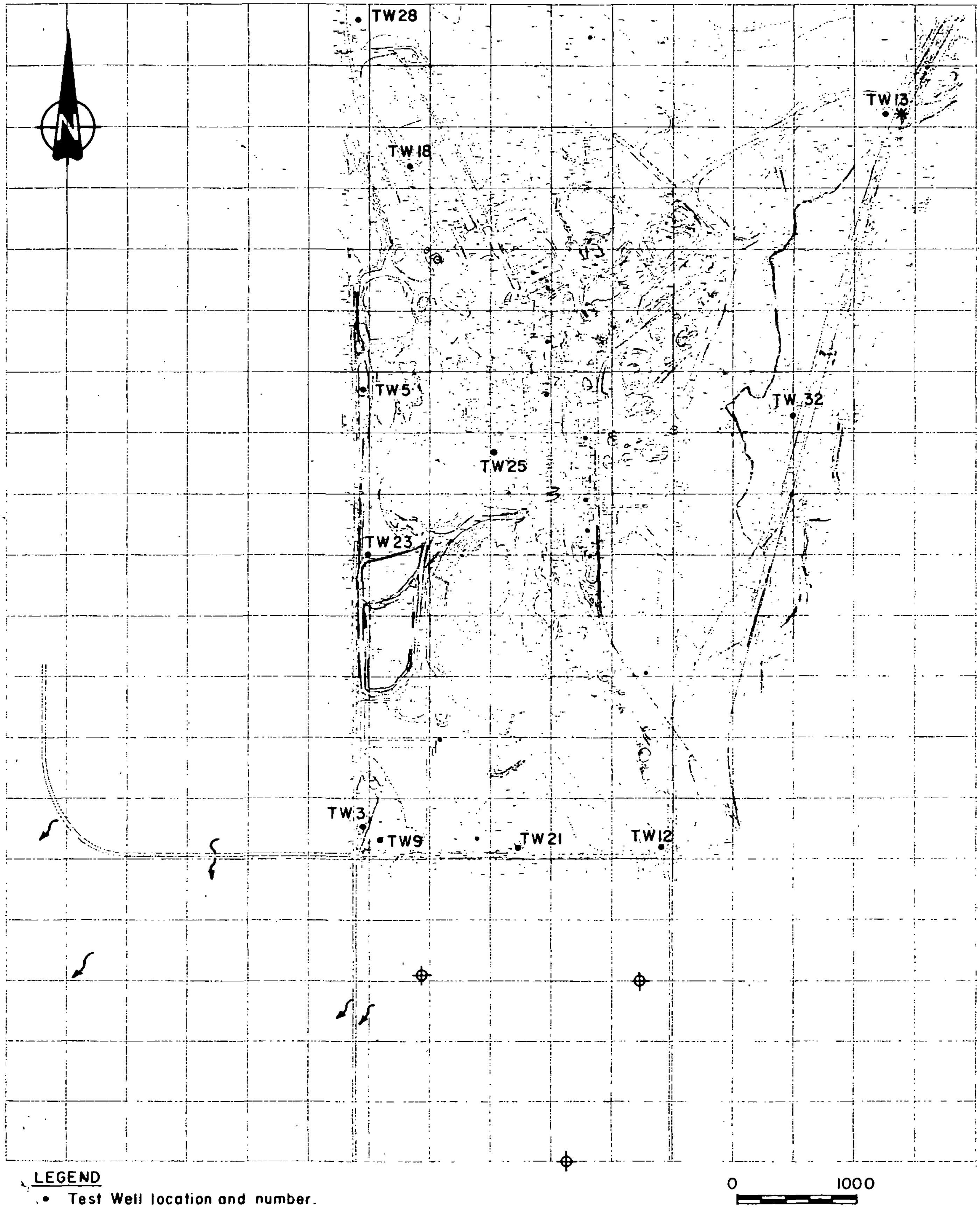
LOWER BASALT ZONE BASE MAP

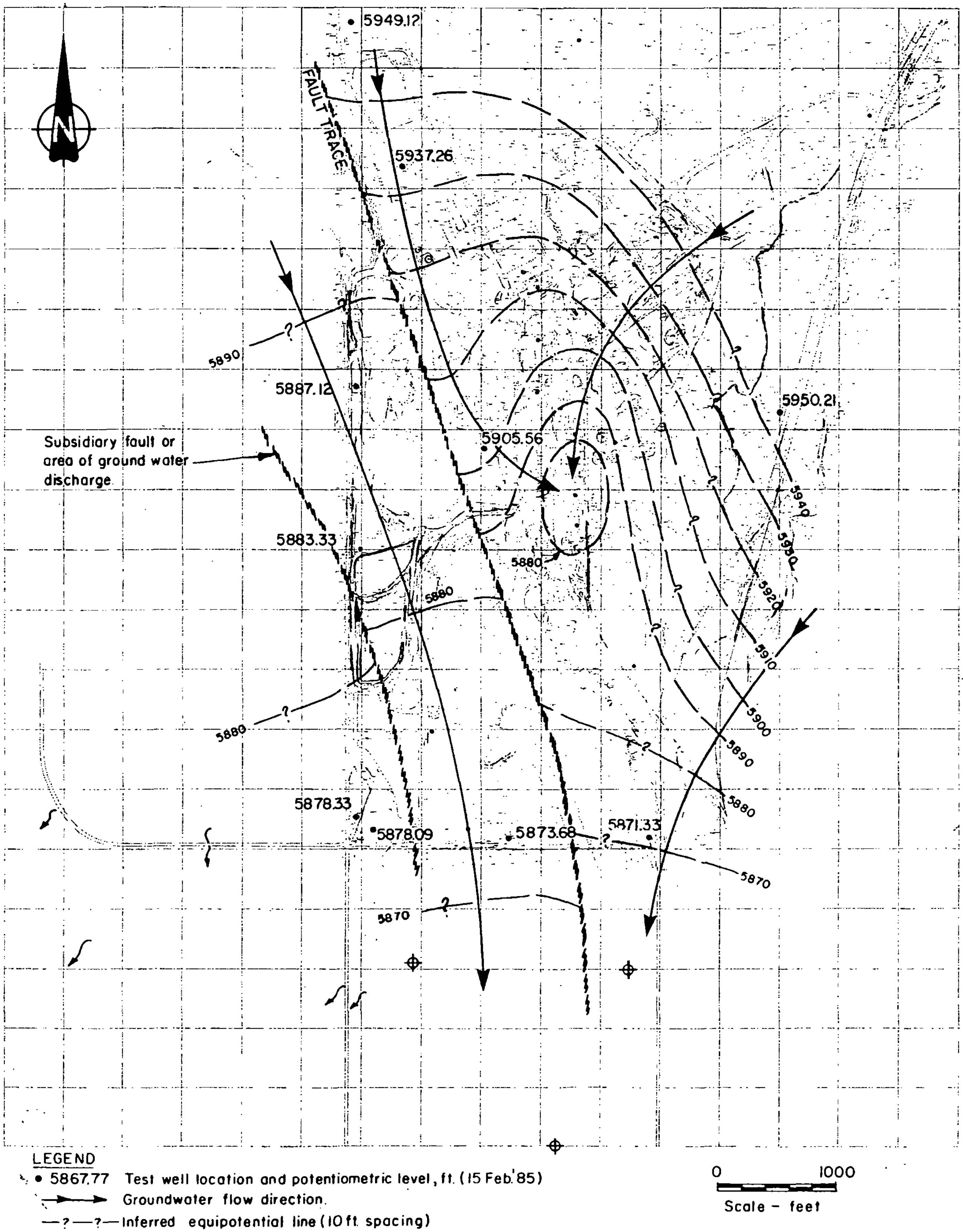
Figure 5.22



LEGEND
- • Test Well location and number.
- ✱ Deep Test Well at this location is completed in Salt Lake Formation.

LOWER BASALT ZONE GROUNDWATER FLOW DIRECTIONS (ASSUMING STRUCTURAL INFLUENCE)

Figure 5.23



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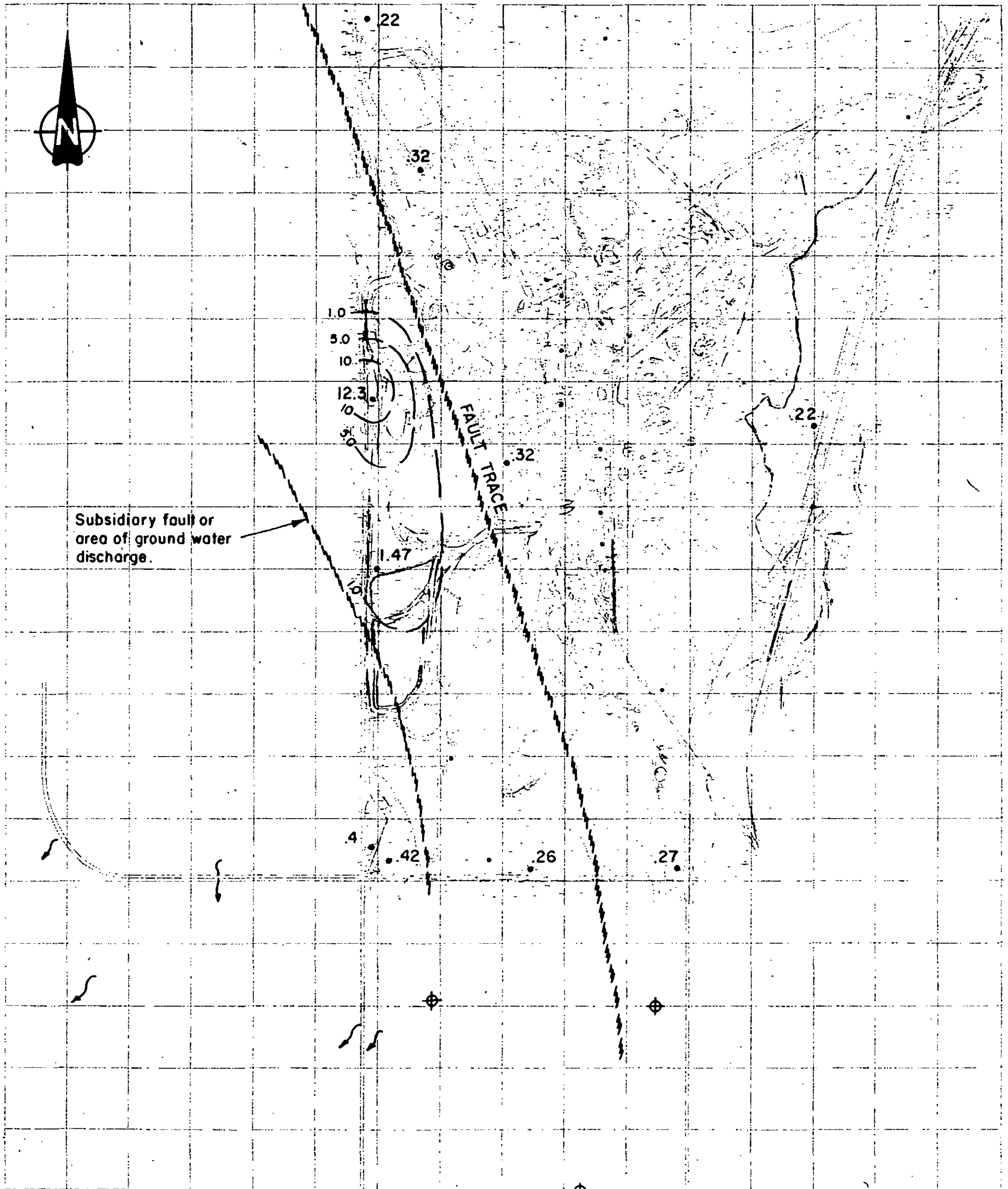
LOWER BASALT ZONE
FLUORIDE
(STRUCTURAL INFLUENCE)

Figure 5.24

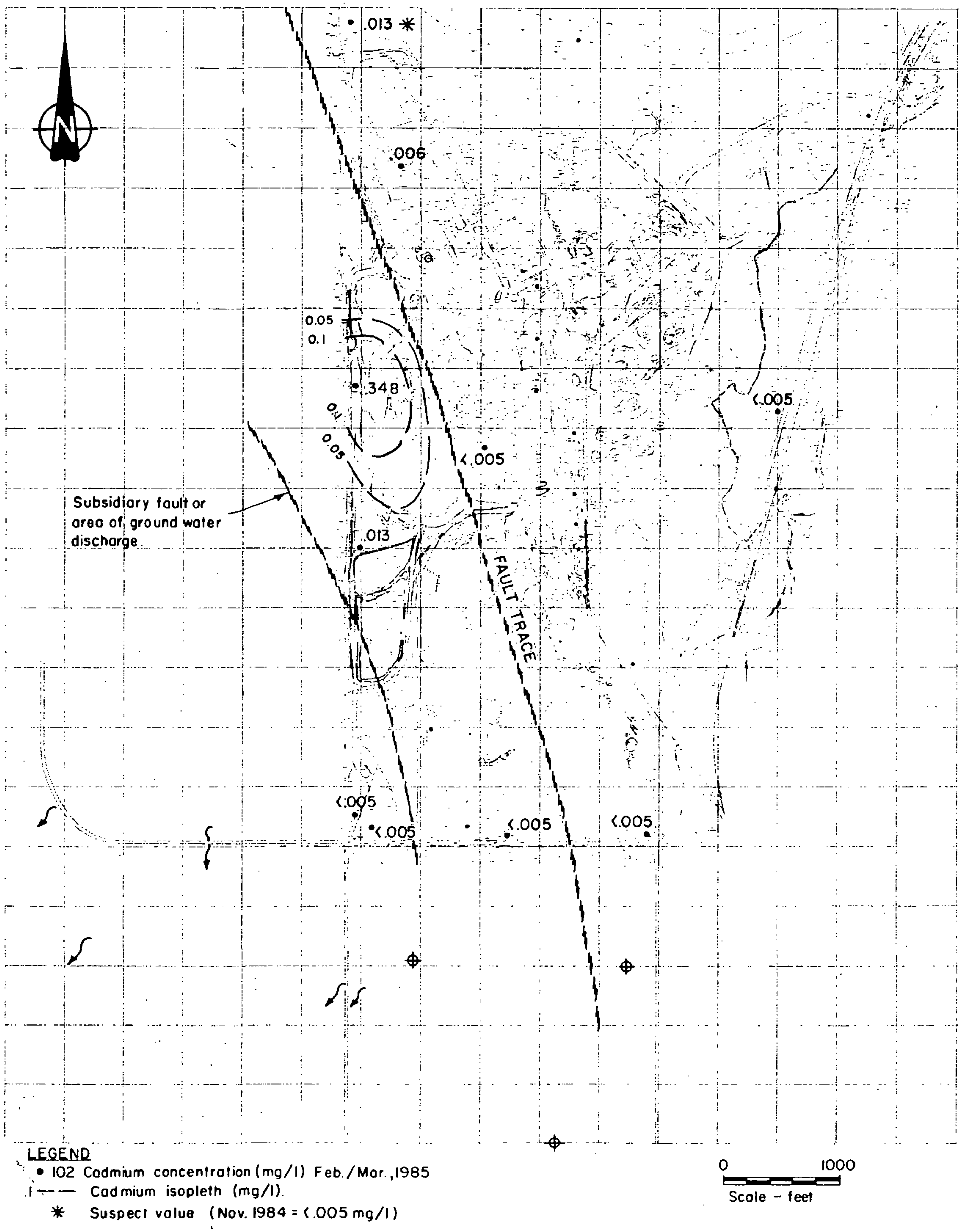


LEGEND
• .32 Fluoride concentration (mg/l) Feb./Mar., 1985
5 ——— Fluoride isopleth (mg/l)

0 1000
Scale - feet

LOWER BASALT ZONE
CADMIUM
(STRUCTURAL INFLUENCE)

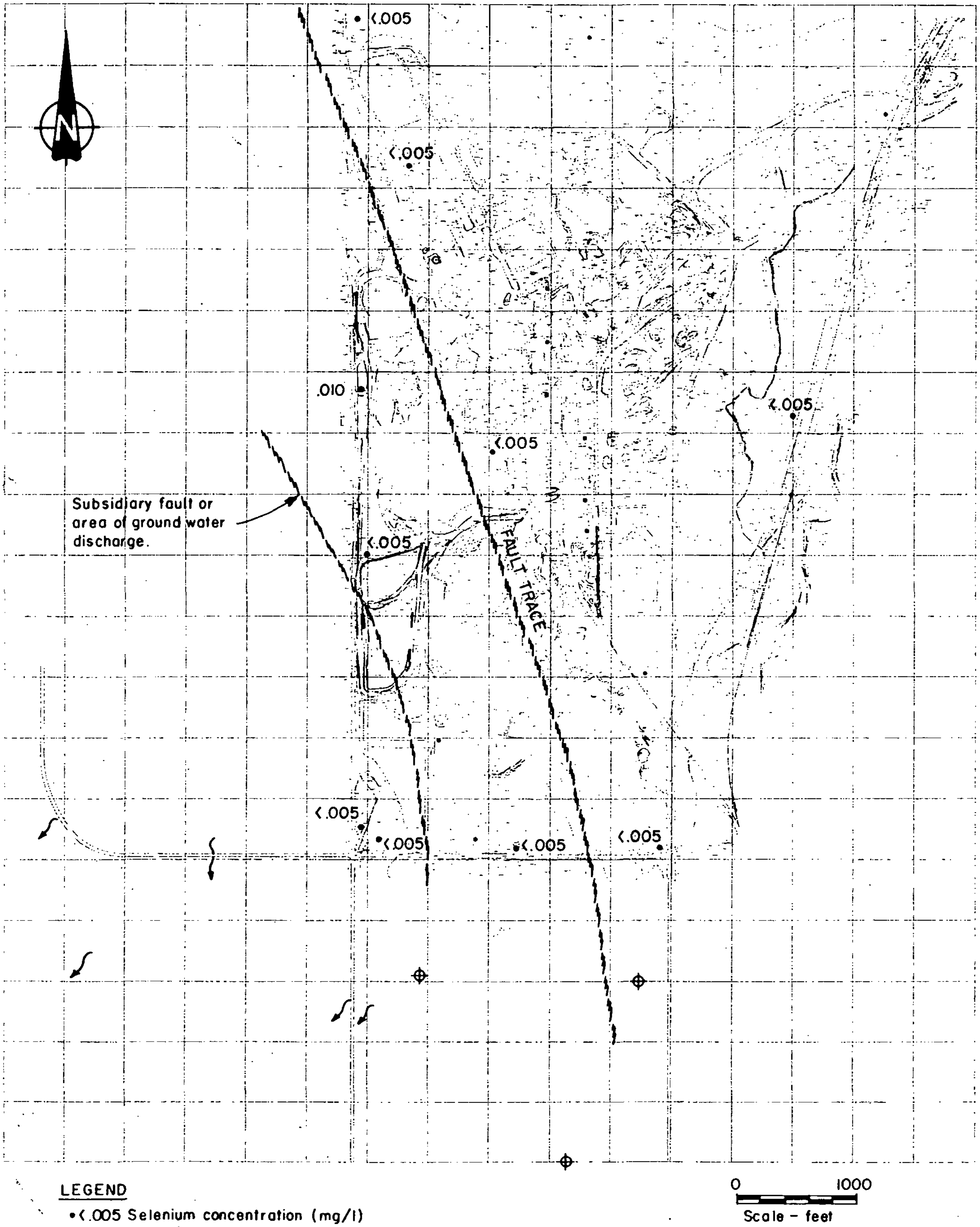
Figure 5.25



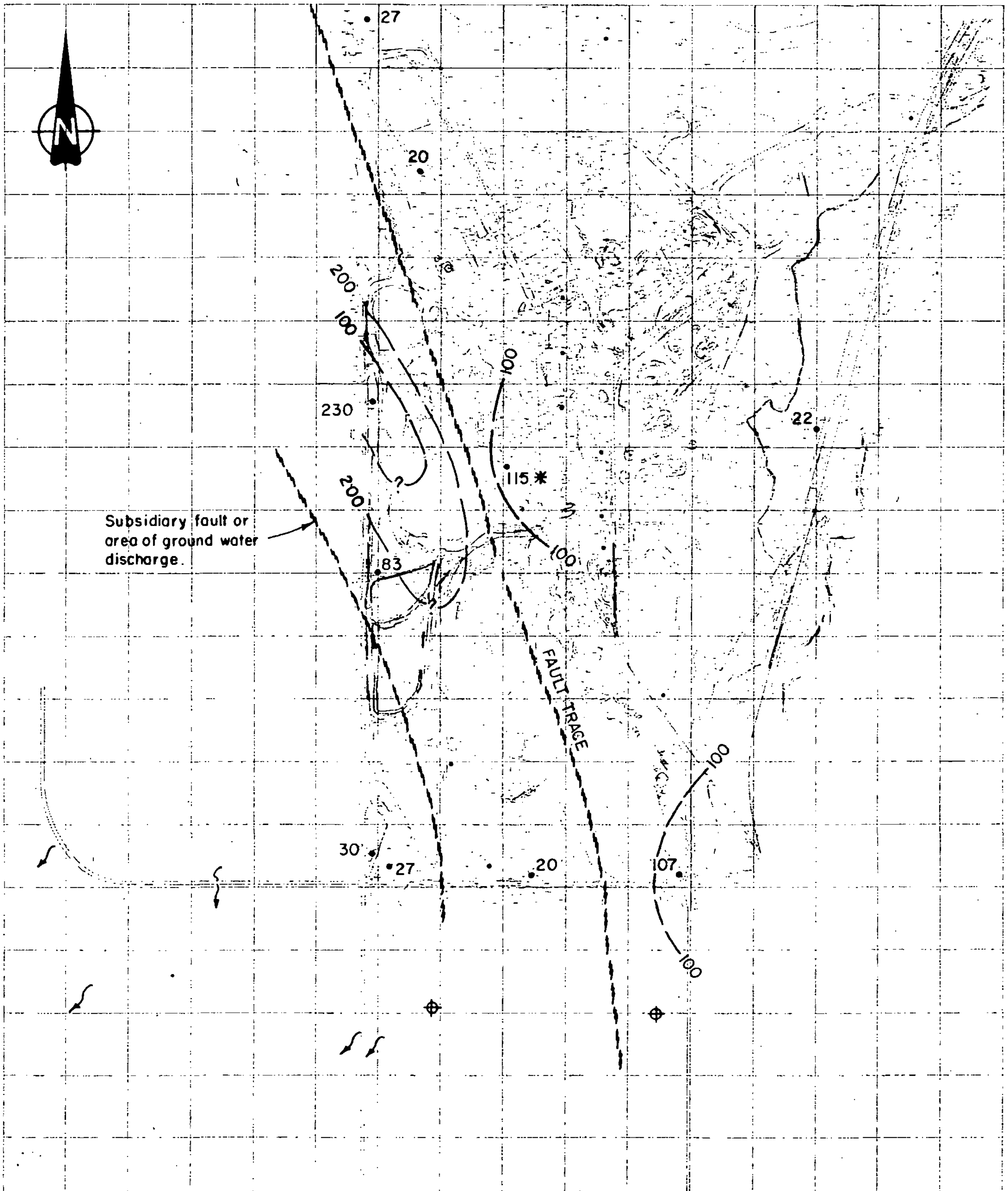
Golder Associates

LOWER BASALT ZONE
SELENIUM
(STRUCTURAL INFLUENCE)

Figure 5.26



LOWER BASALT ZONE CHLORIDE (STRUCTURAL INFLUENCE)	Figure 5.27



LEGEND

• 32 Chloride concentration (mg/l) Feb./Mar. 1985

100 —— Chloride isopleth (mg/l)

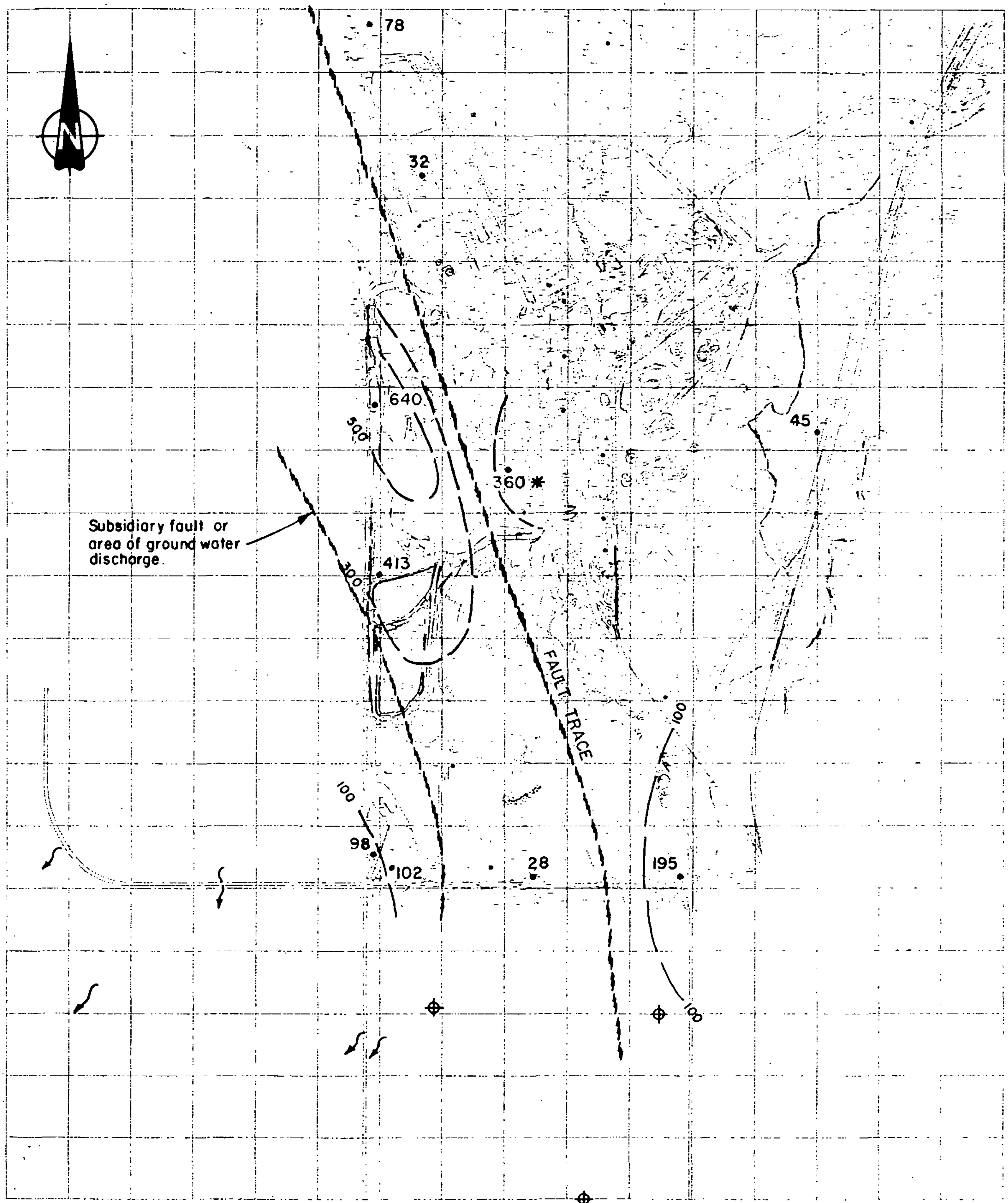
* Suspect data due to grout affected chemistry

0 1000 Scale - feet

Golder Associates

LOWER BASALT ZONE
SULFATE
(STRUCTURAL INFLUENCE)

Figure 5.28



LEGEND

• Sulfate concentration (mg/l)

500 — — Sulfate isopleth (mg/l)

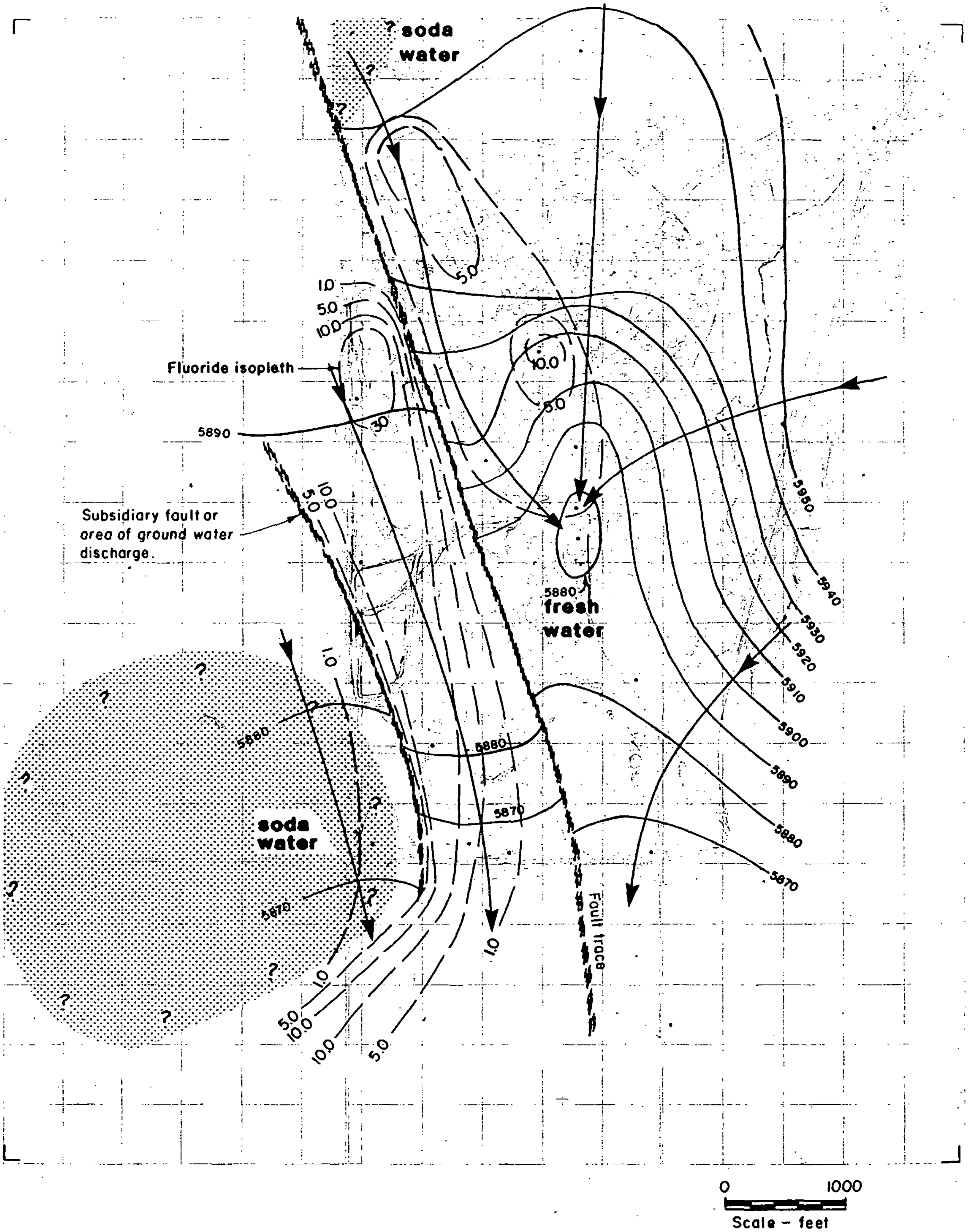
✱ Suspect data due to grout affected chemistry.

0 1000

Scale - feet

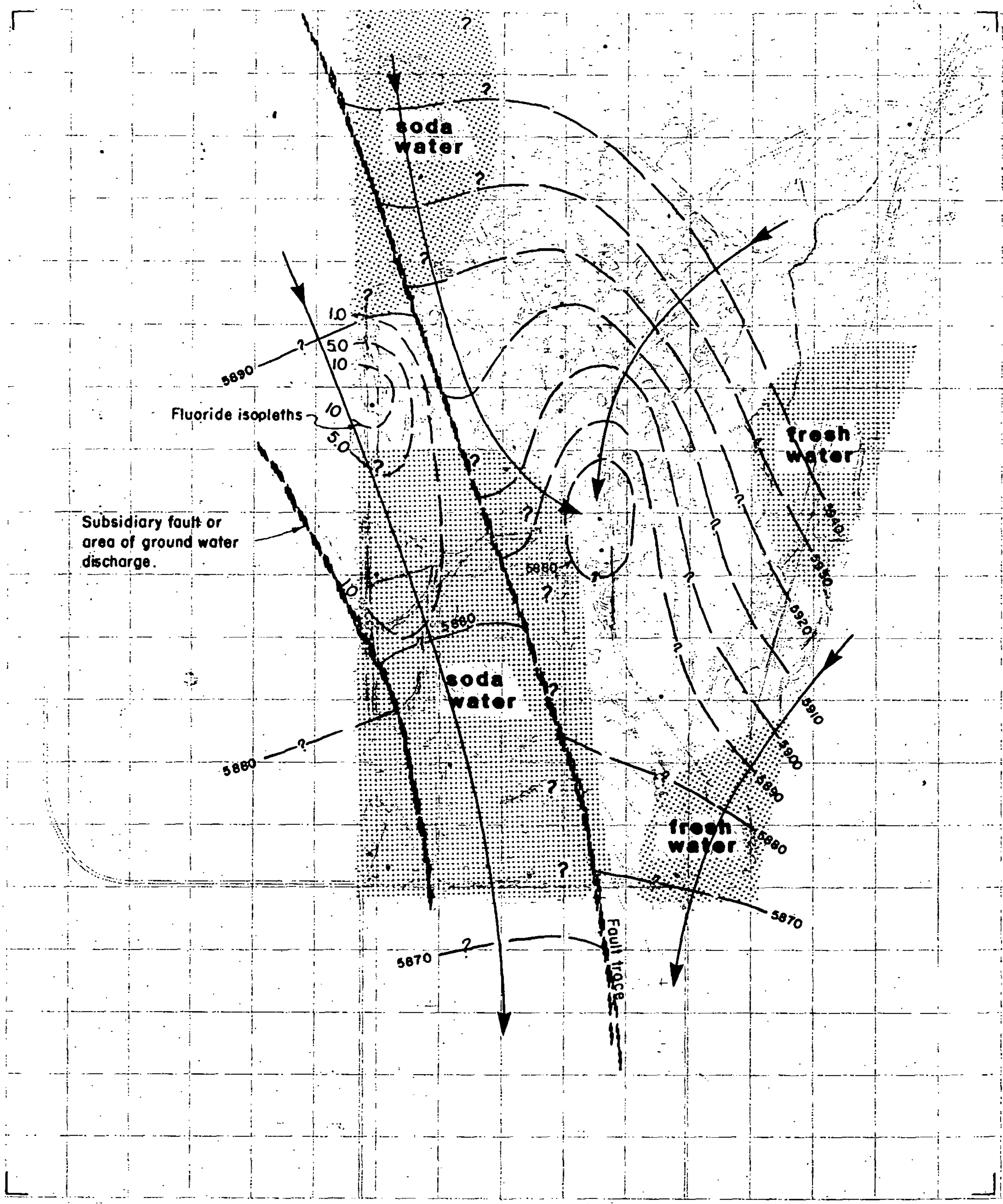
UPPER BASALT ZONE
FLOW DIRECTION AND GEOCHEMISTRY

Figure 5.30



LOWER BASALT ZONE
FLOW DIRECTION AND GEOCHEMISTRY

Figure 5.31



6.0 IMPACT OF OPERATIONS ON WATER QUALITY

6.1 General

The purpose of this section is to present and discuss the hydrogeochemical data for the purpose of assessing the impact of past plant operations on the local water quality. This is accomplished by firstly identifying the level of confidence in the available water quality data based on the QA/QC results. Subsequently, the distribution of specific ions within the ground water system is presented and discussed to identify the origin and characteristics of specific ion plumes; on-site sources are identified. Statistical methods have also been carried out on the data to corroborate the evidence for possible on site sources of specific ions.

The section also includes a brief discussion concerning the potential mobility of specific ions within the ground water flow system and identifies the possible mechanisms of solute transport along ground water flow paths.

6.2 Specific Parameter Isopleths

Analysis of ground waters and spring waters both on and off the Monsanto plant site shows apparently elevated concentrations of various ions which could originate from past and/or current plant site operations. These ions are fluoride, cadmium, selenium, chloride, sulfate and vanadium.

Prior to discussing contour plots of these specific ions, it is necessary to review the implications of the QA/QC results presented in Section 4.6.3. These results suggest that the sulfate analysis are valid but not very exact. This indicates that sulfate is present in the ground water; however, the actual concentration could be somewhat different from the reported value. The magnitude and orientation of contours based on sulfate data is therefore suspect. For fluoride, chloride and vandium the QC data indicates that the reported concentrations are both valid and exact (i.e., the ions are present in the ground water at or very close to the reported concentrations; repeated measurements would give similar concentrations. Therefore the magnitude and orientations of the isopleths is representative. For cadmium and selenium, there is the possibility that the reported concentrations are not accurate at concentrations close to the limits of detection. These data are therefore suspect. At higher concentrations, there is good confidence in the reported concentrations for these ions.

6.2.1 Upper Basalt Zone

Two possible distributions for each specific ion within the ground waters of the Upper Basalt Zone were presented in Section 5.0. Figures 5.9 and 5.14 inclusive presented visually interpolated ion concentration contours of the data irrespective of structure, while Figures 5.16 to 5.21 inclusive presented ion concentration contours based on the most probable groundwater flow directions (incorporating structure). Based on the available data, we consider that Figures 5.16 to 5.21 inclusive represent the most probable ion distributions in the Upper Basalt Zone.

The contour plots for fluoride, cadmium and selenium (Figures 5.16, 5.17 and 5.18 show three areas of relatively high ion concentration: an area toward the northwest corner of the plant site, an area towards the north on the western boundary of the plant site and an area towards the north in the central portion of the plant site. The specific areas of relative high concentration are each based on data from a single test well. It is probable that additional test wells would change the location of specific isopleths. However, it is considered that the general pattern of isopleths would remain relatively unchanged.

Figures 5.16, 5.17 and 5.18 show two discrete ion plumes, each generally orientated in the general direction of ground water flow. The plume to the southwest of the hinge fault appears to originate in the area of the old underflow solids ponds. The plume extends southwards over a relatively narrow band (approximately 1500 ft wide) and is apparently bounded to the east by the hinge fault and to the west by the subsidiary fault or ground water discharge area. It is probable that some ground water mixing takes place across the faults/discharge zone and as a result there is a transition zone between the different ground water types.

The fluoride plume (Figure 5.16) extends south of the plant site to at least Calf or Mormon Springs. Some mixing with ground waters to the west of the subsidiary fault/ground water discharge area also appears to have taken place based on the the fluoride concentration in TW10.

The cadmium plume (Figure 5.17) appears to be restricted to the plant site area but the selenium plume (Figure 5.18) may extend south of the plant site although not as far as the fluoride plume. The fluoride, cadmium and selenium plumes are present in the Upper and Lower Basalt Zone immediately south of the old underflow solids pond (for a discussion of the Lower Basalt Zone, see Section 6.2.2). In the southern plant site area, these ion plumes are found only in the Upper Basalt Zone within and above the $\gamma 4$ horizon/cinder zone. It appears that the upward component of hydraulic gradient in this area (Figure 4.4) prevents the downward seepage of these ions to the Lower Basalt Zone.

The fluoride, cadmium and selenium plume to the northeast of the hinge fault appears to originate in the areas of the old northwest pond and old hydro-clarifier. The plume extends southeastwards and is absent southeast of the plant production wells. Near the old northwest pond the plume is present within the $\gamma 3$ cinder zone and within the cinder zone found some 20 to 30 ft below the $\gamma 3$ horizon. There is an upward component of hydraulic gradient in this area which probably prevents the seepage of contaminated ground water to greater depths (i.e., the Lower Basalt Zone) at this location. Closer towards the plant production wells, it appears that pumping has probably reversed the natural vertical components of hydraulic gradient allowing seepage downwards from the Upper Basalt Zone to the Lower Basalt Zone. It is therefore possible that the plume may be present in both the Lower and Upper Basalt Zone to the north of the plant production wells. (For a discussion of the Lower Basalt Zone, see Section 6.2.2). Figure 5.30 indicates that the pumping of the plant production wells creates a cone of depression in the central plant site area preventing the southeasterly migration of the ground water plume originating in the northwest plant site area.

The contour plots of chloride and sulfate concentrations from the Upper Basalt Zone, considering structure (Figures 5.19 and 5.20, respectively) are fairly similar in shape to Figures 5.16, 5.17 and 5.18 in the western and central plant site areas. The sulfate plume extends south of the plant site to at least Calf and Mormon Springs while the chloride plume appears to be restricted to the plant site area. The chloride isopleths (Figure 5.19) also appear to indicate some localized leakage from either the effluent stream or ponds into the Upper Basalt Zone in the southwest plant site corner. The chloride and sulfate isopleths in the southeast corner of the plant site show an area with relatively high (300 - 500 mg/l) sulfate and chloride concentrations.

It appears likely that the chloride and sulfate distributions in this area represent the westerly edge of a southward migrating plume whose center lies some distance east of the plant site.

The vanadium isopleths (Figure 5.21) are somewhat similar to that of chloride and sulfate in the southeast plant site area. It appears that a vanadium plume exists in this area orientated in a south to south-westerly direction. Limited data precludes a full delineation of the vanadium plume however. Figure 5.21 also indicates three smaller vanadium plumes; in the area of the old underflow solids pond, southeast of the northwest pond and southeast of the old hydro-clarifier.

6.2.2 Lower Basalt Zone

The contour plots of ion concentrations (considering structure) from the Lower Basalt Zone for fluoride, cadmium and selenium (Figures 5.24, 5.25 and 5.26, respectively) only show one area of relatively high ion concentrations. The area is located towards the north on the western plant site boundary. This area lies immediately beneath an area in the Upper Basalt Zone of relatively high ion concentration of these specific parameters. In addition, this area shows a downward component of hydraulic gradient between the Upper and Lower Basalt Zones (see Figure 4.4). However, the specific area of relatively high ion concentration is primarily based on data from a single test well (TW5) and the completion integrity of this well is suspect. The well bore may be the pathway for downward migration of contaminants. It is probable that additional test wells would change the specific location and/or orientation of the isopleths, but, it is considered by Golder Associates that the general pattern of isopleths would remain relatively unchanged. The migration of these specific ions is considered to be generally towards the south along ground water flow lines.

The contour plots of ion concentrations from the Lower Basalt Zone for chloride and sulfate (Figures 5.27 and 5.28, respectively) are fairly similar in shape to Figures 5.24, 5.25 and 5.26 in the western plant site area. These figures also show two additional areas of relatively high ion concentration located in the southeast corner of the plant site and the central plant site area. There are also elevated concentrations of sulfate, chloride and vanadium in the Upper Basalt Zone at this location and it is considered likely that the ion concentrations observed in the Lower Basalt Zone are associated with the plume in the Upper Basalt Zone (Section 6.2.1). The elevated sulfate and chloride concentrations in test well TW25 in the central plant site area are suspect since it appears that the water quality has not equilibriated with the local environment following drilling disturbance.

The vanadium contour plot from the Lower Basalt Zone (Figure 5.29) shows no areas of elevated ion concentrations; all water samples from the February/March, 1985, tests were below the minimum detection level of 0.05 mg/l.

6.3 Sources of Specific Ions

Apparent sources of fluoride, cadmium, selenium, chloride, sulfate and vanadium at the Monsanto site are identified by their relative concentrations in the ground water system(s). It was not part of Golder Associates Terms of Reference to conduct a records search or investigation of past disposal practices. Potential sources (past and present) existing at the Monsanto site were not investigated or physically/chemically characterized. Monitoring ground water quality identified areas in which ground water apparently has been impacted, or is currently being impacted.

The apparent sources identified by this study are suggested in Figures 5.16 to 5.21 and 5.24 to 5.29 inclusive, by the centers of ion concentration. In general, for the Upper Basalt Zone these centers of ion concentration correlate with the northwest pond, the old underflow solids pond, the new sealed underflow solids pond, the old hydro-clarifier and/or an area to the east of the plant site (Plate 1). It should be noted that the old open bottom hydro-clarifier was replaced with a new sealed system in August 1985. One center of ion concentration for the Lower Basalt Zone correlates with the area below the old underflow solids pond, the other center appears to be east of the Monsanto plant site. These implied source areas have only been termed "apparent sources", since the contour plots only show the relative spatial distribution of the raw geochemical data for the February/ March, 1985, sampling period. The relative spatial distribution of the raw geochemical data, and thus the orientation and magnitude of the isopleths, may or may not be statistically significant. To verify the statistical significance of the geochemical data, the EPA accepted student "T" test was performed for each suspected ion on upgradient and downgradient test well pairs.

The student "T" test is a statistical procedure to determine whether the means of two small sample groups, assumed to be normally distributed are equivalent within some confidence interval. The calculations for this study were made by the Statistical Package for Social Science (SPSS version 8.3) using the data from the October/November 1984 and February/ March 1985 sampling periods, and assuming a 95 per cent confidence interval. For the Upper Basalt Zone, test wells TW15 and TW29 were used as background water quality test wells. These two test wells were checked against each other for a significant difference using a two-tailed test (the results are shown in Table 6.1). Since there was no significant difference between test wells TW15 and TW29 for each ion tested, and because of the limited data, the geochemical data from the

TABLE 6.1

ONE-TAILED PROBABILITY FOR COMPARING
TWO GROUPS OF TEST WELLS,
UPSTREAM AND DOWNSTREAM OF SOURCES

ZONE	WELLS TESTED	F	Cd	Se	SO_4	Cl	V
Upper	TW16* vs TW15,TW29	0.000	0.009	0.000	0.002	0.000	0.000
Basalt	Significant Difference	Yes	Yes	Yes	Yes	Yes	Yes
Zone	TW30* vs TW15,TW29	0.002	ND	0.056	0.000	0.051	0.247
	Significant Difference	Yes	No	No	Yes	No	No
	TW37* vs TW15,TW29	0.000	0.000	0.000	0.000	0.000	0.001
	Significant Difference	Yes	Yes	Yes	Yes	Yes	Yes
	TW40* vs TW15,TW29	0.000	0.000	0.000	0.000	0.000	0.001
	Significant Difference	Yes	Yes	Yes	Yes	Yes	Yes
	TW15 vs TW29(1)	0.687	ND	ND	0.984	0.089	0.300
	Significant Difference	No	No	No	No	No	No
	TW30* vs TW16*	TW16>TW30	TW16>TW30	TW16>TW30	0.006	0.096	TW16>TW30
	Significant Difference	No	No	No	Yes	No	No
	TW40* vs TW16,TW30	0.010	0.000	TW16,TW30	0.000	0.000	0.288
	Significant Difference	Yes	Yes	>TW40	Yes	Yes	No
Lower	TW5* vs TW18,TW28	0.022	0.078	0.004	0.000	0.062	ND
Basalt	Significant Difference	Yes	No	Yes	Yes	No	No
Zone	TW18 vs TW28(1)	0.170	0.477	0.542	0.781	0.214	ND
	Significant Difference	No	No	No	No	No	No
	TW5* vs TW28	0.022	0.030	0.027	0.002	0.018	ND
	Significant Difference	Yes	Yes	Yes	Yes	Yes	No
	TW5* vs TW18	0.002	0.078	0.018	0.000	0.062	ND
	Significant Difference	Yes	No	Yes	Yes	No	No

*Indicates Test Well Downstream of Source

NOTES:

(1) Used two-tailed test F15, V15 > F29, V29 for other constituents the level in
F18 > F28 TW 28 or TW 29 was higher.

ND = Indicates no difference in the means, therefore no significant difference

If the probability is less than 0.05 (95% confidence interval) then the difference in the means between the two groups is considered to be significant.

For values below minimum detection level (BMD), especially when more than one value tested is BMD, the maximum deviation was assumed.

two test wells were lumped together as a background source. This background source data was then tested against data from test wells downgradient from suspected sources (test wells TW16 and TW37) for a significant difference at the 95 per cent confidence level using a one-tailed test (the results are shown in Table 6.1). Where ground water had travelled past a suspected source, the background water quality was assumed to have changed, and thus an upgradient/downgradient set of wells were tested. For the Lower Basalt Zone, test well TW28 was used as the background well and test wells TW18 and TW5 were assumed to be downgradient test wells.

Since the average linear flow rate is large (Section 5.3.2) and the distance between test wells is relatively short, a significant difference in the "T" test may suggest that a source of the specific ion exists between the test wells or at the downstream test well. This assumes that the background or upgradient and downgradient water quality was the same, with respect to the specific ion prior to introduction of the source. On the other hand, no significant difference in the test results suggests that with respect to the specific ion no source exists. The degrees of freedom for each test were calculated by the SPSS computer analysis. A small value for degrees of freedom should cause concern about the normality of the sample population, and thus the reliability of the statistical test.

If the student "T" statistical test is considered to be valid, then the sources suggested by centers of ion concentration must be re-evaluated.

At those places where an ion shows a center of concentration, but the student "T" test is not significant, there is statistically no source. A summary of student "T" test results for statistical source areas by ion is shown on Table 6.2. A portion of these analyses assume

TABLE 6.2

SOURCES OF SPECIFIC IONS SUGGESTED BY STUDENT "T" TESTS

Upper Basalt Zone

	OLD UNDERFLOW SOLIDS POND	NORTHWEST POND	CURRENT UNDERFLOW SOLIDS POND	HYDRO-CLARIFIER
Fluoride	Yes	Yes	No	Yes
Cadmium	Yes	Yes	No	Yes
Selenium	Yes	Yes	No	No
Chloride	Yes	Yes	No	Yes
Sulfate	Yes	Yes	Yes	Yes
Vanadium	Yes	Yes	No	No

Lower Basalt

	OLD UNDERFLOW SOLIDS POND	NORTHWEST POND
Fluoride	Yes	No
Cadmium	No	No
Selenium	Yes	No
Chloride	No	No
Sulfate	Yes	No
Vanadium	No	No

that water quality of TW28/TW29 is the background water quality for TW5/TW37. However, this assumption may not be true. For the Lower Basalt Zone, the old hydro-clarifier and the current underflow solids ponds are not evaluated as a source since downgradient deep wells do not exist.

In summary, the results of the statistical analysis generally confirm the source areas identified by the examination of the ion isopleth distributions. It appears that there are three on-site source areas acting to impact ground water quality under the plant site. These are:

- o the old underflow solids pond
- o the northwest pond
- o the old hydro-clarifier.

The location of these sources is shown on Plate 1.

The old underflow solids pond and northwest pond locally impact ground water quality in the Upper Basalt Zone with elevated concentrations of fluoride, cadmium, selenium, chloride, sulfate and vanadium. The old open bottom hydro-clarifier was a localized source for fluoride, cadmium, chloride and sulfate impacting ground waters of the Upper Basalt Zone, but was replaced by a new sealed system in August, 1985.

The current underflow solids pond does not appear to be impacting the ground water quality.

Ground water quality in the Lower Basalt Zone appears to be impacted by the old underflow solids ponds, but may in fact be impacted by leakage down the poorly sealed well bore of test well TW5.

6.4 Solute Mobility and Fate

6.4.1 Introduction

As a concluding section to this report, we have briefly reviewed the mobility (movement within the ground water system) of solutes entering the ground water system as a result of past and/or current operations at the plant site. The relative mobilities of particular solutes provide an insight into some of the chemical reactions which might occur along flow paths. The fate of a solute refers to the time dependent concentration of a particular solute within the ground water system. The fate of fluoride and cadmium compounds has been assessed using saturation indices to provide some degree of insight into the possible future concentrations of these compounds that could be expected in the local ground water system.

6.4.2 Solute Mobility

The Upper Basalt flow system on the west side of the hinge fault is used for comparing relative mobilities of particular solutes. In particular, test wells TW37, TW36 and Mormon Spring were used in the analysis. The relative mobilities of fluoride, cadmium, selenium, sulfate and chloride were assessed by using the ratios of solute concentrations along the flow path from TW37 to TW36 to Mormon Spring. The solute concentration observed in each well was initially adjusted for background concentrations. The background concentrations were estimated from water quality from TW28, TW29 and TW2, and are approximately:

Fluoride	=	0.4 mg/l
Cadmium	=	0
Selenium	=	0
Sulfate	=	75 mg/l
Chloride	=	25 mg/l

TABLE 6.3

SOLUTE CONCENTRATION RATIOS FROM
TEST WELLS TW37, TW36 AND MORMON SPRING
(February/March 1985 Sampling Period)

PARAMETER RATIO	TW37	TW36	MORMON SPRING
Cl/SO4	0.36	0.24	0.24
F/SO4	0.05	0.04	0.04
F/Cl	0.15	0.15	0.18
Se/SO4	0.0001	0.0003	0.00004
Se/Cl	0.0003	0.001	0.0002
Cd/SO4	0.002	0.0002	0.0002
Cd/Cl	0.006	0.0007	0.0007
Cd/Se	18.	0.7	4.

The resulting solute ratios are presented in Table 6.3. Chloride and sulfate are normally conservative (non-reactive) in most geochemical environments and are mobile in ground water flow systems. The ratios for Cl/SO_4 are consistent (considering sampling and analysis errors) and indicate that these ions are migrating along the flow path with similar mobility. The ratios between fluoride and sulfate and chloride are also consistent along the flow path, and thus indicate the fluoride solute to be as mobile as sulfate and chloride.

The ratios between cadmium and that of sulfate and chloride indicate a significant reduction of cadmium relative to the other solutes from test wells TW37 to TW36, but from test well TW36 to Mormon Spring the ratios are the same. Selenium ratios with respect to sulfate and chloride show a different pattern from cadmium. Selenium increases relative to sulfate and chloride from test wells TW37 to TW36, and then decreases from test well TW36 to Mormon Spring. These results indicate that both cadmium and selenium are not as mobile as fluoride, sulfate and chloride. Selenium appears to be slightly more mobile than cadmium, but the results are unclear since selenium's largest value in this flow system is in test well TW36 instead of test well TW37.

6.4.3 Saturation Indices

The saturation indices of a particular mineral phase provide an insight into the dissolution-precipitation reactions taking place at a particular point in time or space. The saturation index can be used to obtain an understanding of the geochemical behaviour and controls on the ground water in a particular environment. For the purpose of the present study, the fate of the fluoride and cadmium compounds in the local ground water system has been assessed. In particular, attention focussed on the fluoride and cadmium plumes indentified in Section 6.2 of this report.

Various geochemical equilibrium models are available for the calculation of saturation indices; for example WateqF and Wateq2 prepared by the United States Geological Survey. Details of these models are found in Plummer, Jones and Truesdell (1976) and Ball, Nordstrom and Jenne (1980). For the determination of saturation indices, fluorite is the controlling fluoride mineral and cadmium carbonate is the controlling solid phase for cadmium in the local system. A review of the geochemical models indicated that both models use a different solubility or equilibrium constant for fluorite. No differences in the solubility constant for cadmium carbonate were found.

As a result of the reported differences in the fluorite solubility constant, Golder Associates contacted a number of geochemical specialists and researchers actively working in the area of fluorite geochemistry. Discussions were held with Dr. E. Reardon (University of Waterloo, Ontario, Canada), Mr. E. Jenne (Batelle Northwest Laboratory) and Mr. D.K. Nordstrom (U.S. Geological Survey). The overall conclusions regarding fluorite solubility and kinetics from the discussions are as follows:

- o The exact solubility constant for fluorite is presently undetermined. Nordstrom believes research is needed to determine the exact value.
- o The solubility constant for fluorite of $10^{-11.09}$ as presented by Ball, Nordstrom and Jenne 1980 in the Wateq2 geochemical model is too low.
- o The solubility constant for fluorite of $10^{-9.79}$ as presented in the CRC Handbook of Chemistry and Physics (62nd Edition) may be too high.
- o The solubility constant for fluorite of $10^{-10.54}$ as presented by Plummer, Jones and Truesdell, 1976 in WateqF is close to the solubility constant perceived by Nordstrom based on reported field observations by other researchers.
- o The kinetics of fluorite equilibria are not slow; equilibrium should be obtained from an oversaturated condition within a time period of weeks to several months in most natural ground waters.

As a result of the differences in the solubility constant for fluorite, fluorite saturation indices were calculated based on the most likely upper and lower bound values for the solubility constant. An upper bound solubility constant for fluorite of $10^{-9.79}$ (CRC) and a lower bound value of $10^{-10.54}$ (WateqF) were adopted. Cadmium carbonate saturation indices were calculated based on a solubility constant of $10^{-11.19}$ as presented in Wateq2. Saturation indices calculations were performed on a limited number of groundwaters representative of the Monsanto plant site (Table 6.4). The groundwaters not presented in this table are undersaturated with respect to both fluorite and cadmium carbonate with the possible exception of Calf spring. Calf spring is probably oversaturated with respect to fluorite since the water quaity from this spring is similar to that of Mormon spring and the SWG well which are located closeby.

6.4.3 Fluorite

Table 6.4 indicates that the two fluorite equilibrium constants give different fluorite saturation indices. Although the ground waters are generally oversaturated with respect to fluorite using both solubility constants, the levels of saturation are lower using the CRC fluorite solubility constant. It should also be noted that groundwater from TW39 and TW17 is oversaturated with respect to fluorite using the WateqF fluorite solubility constant but undersaturated using the CRC solubility constant. In order to define the most probable fluorite solubility constant, the kinetics of the fluorite system were examined in the light of estimated groundwater velocities under the plant site.

Current research indicates that the fluorite system is not slow and that equilibrium (saturation index = 1) should be reached in a period of weeks to several months. Therefore, depending on the groundwater velocities, fluorite equilibrium could be reached a very short distance downgradient of the source if groundwater travel times are slow or

TABLE 6.4

Saturation Indices

Sampling Location	Fluorite (1)	Fluorite (2)	Cadmium Carbonate
TW5	2.5	14	0.07
TW6	3.6	20	0.002
TW16	1.1	6	0.76
TW17	0.3	1.6	0.002
TW22	3.4	19	0.04
TW36	2.3	13	0.02
TW37	25	140	0.82
TW39	0.5	2.6	N/A
TW40	3.6	2.0	0.26
SWG	1.0	5.4	N/A
Mormon Springs	1.9	11	0.02

Notes: Saturation indices greater than 1 indicate oversaturation with respect to the mineral. Indices based on February/March 1985 geochemical data.

N/A Saturation indices could not be calculated since concentrations were less than detection.

(1) Saturation index determined using $10^{-9.79}$ for solubility constant.

(2) Saturation index determined using $10^{-10.54}$ for solubility constant.

further downgradient if travel times are faster. We estimate that the ground water velocity to the west of the hinge fault is about 150 ft/day, however we consider the more probable range is between 20 to 200 ft/day. Based on this range, the travel time for ground water to flow from the old underflow solids ponds (the fluoride source), to SWG or Mormon Springs (a distance of about 4500 - 5000 ft) would be between 1 to 8 months. Considering these travel times and the kinetics of the fluorite system, we consider that fluorite equilibrium should be reached (or be very close to equilibrium) in the southern area of the plant site and in the area of SWG and Mormon Spring. Therefore, fluorite saturation indices should be at or close to 1.0 (equilibrium) in these areas. Examination of Table 6.4 indicates that the fluorite saturation indices calculated using a fluorite solubility constant, presented by CRC of $10^{-9.79}$, most resembles the distribution that would be expected considering the estimated range of ground water velocities. Golder Associates therefore believes that the actual fluorite solubility constant in the plant site environment may be close to $10^{-9.79}$ value as presented by CRC.

The fluorite saturation indices calculated using the CRC solubility constant, indicate that the fluorite saturation index decreases southwards from TW37 (S.I.=25) to SWG (S.I.=1.0) and Mormon Spring (S.I.=1.9). The fluorite saturation index calculated for ground water from TW39 is 0.5 which indicates undersaturation and suggests that this test well may be on the fringe of the fluoride plume in the southern plant site area (as shown on Figure 5.16). In the north-central plant site area, the ground water from TW16 and TW40 are oversaturated with respect to fluorite, while TW17 is undersaturated.

The decrease in fluorite saturation downgradient from the source areas is probably due to one or a combination of the following reasons:

- precipitation of fluorite within the basalts/interbeds
- attenuation of fluoride solutes from infiltrating waters, mixing with non fluoride ground waters and/or dispersion of the fluoride solutes within the flow path.

The preliminary conclusions from the fluorite saturation indices indicate that the ground waters for some distance downgradient of the fluoride source areas (the old underflow solids ponds, the northwest pond and the old hydro-clarifier) are oversaturated with respect to fluorite even after some degree of attenuation of the source with the ground water. The source effluents must therefore be oversaturated with respect to fluorite and the potential exists for the precipitation of fluorite within the vadose zone while the source effluents are percolating towards the water table. In addition, fluorite has potentially precipitated within the Upper Basalt Zone from the old underflow solids ponds southwards to approximately the southern boundary of the site. Fluorite has also potentially precipitated in the Upper Basalt Zone downgradient of the northwest pond and old hydro-clarifier and in the Lower Basalt Zone locally downgradient of TW5. The degree and extent of fluorite precipitation in these areas is unknown.

The precipitation of fluorite within the basalt/cinder zones implies that fluoride could be subsequently released to the ground water even after the source is removed. The release of fluoride could be by dissolution within the vadose zone by percolating meteoric waters and/or fluctuating water table and within the aquifer by the throughflow of ground water undersaturated with respect to fluorite. As a result, it appears likely that natural flushing out of the source or fluoride solutes in the ground water may take several months to several years even if the source is removed.

6.4.3.2 Cadmium Carbonate

Cadmium carbonate is undersaturated in all of the groundwater samples analyzed (Table 6.4). Ground waters from TW37 and TW16 show a saturation index of 0.82 and 0.76, respectively (close to saturation) and considering the possible analytical errors in the chemical analyses these groundwaters could be at saturation with respect to cadmium carbonate.

To the west of the hinge fault in the Upper Basalt Zone, cadmium carbonate saturation indices decrease southwards (hydraulically downgradient) from TW37. In the Upper Basalt Zone of the north-central plant site area, the cadmium carbonate saturation indices decrease from 0.76 at TW16 to 0.3 at TW40. In the Lower Basalt Zone cadmium carbonate is undersaturated at TW5. In addition, cadmium carbonate is considered undersaturated in the plant production wells based on the reported cadmium concentrations.

The cadmium carbonate saturation indices decrease downgradient from the cadmium source areas (the old underflow solids ponds, the northwest pond and the old hydro-clarifier) in response to the precipitation of cadmium carbonate within the basalts/cinder zones, attenuation of cadmium solutes by infiltrating waters, mixing with non-cadmium groundwaters, dispersion of the cadmium solutes along the flow paths and absorption onto mineral surfaces. Based on the saturation indices, it is likely that cadmium carbonate has precipitated in the Upper Basalt Zone downgradient of the old underflow solids ponds and northwest pond. The extent of this cadmium precipitate is unknown. It appears unlikely that cadmium carbonate has precipitated in the Upper Basalt Zone downgradient of the old hydro-clarifier.

The preliminary conclusions drawn from the cadmium carbonate saturation indices are that the source effluents from the old underflow solids pond and northwest pond could be oversaturated with respect to cadmium carbonate. As a result, the potential exists for the precipitation of carbonate minerals containing cadmium within the vadose zone while the source is percolating toward the water table. Cadmium could thus be redissolved in these areas by percolating waters for a period of time greater than if cadmium were undersaturated and mobile. Cadmium may not be flushed out of the local groundwater system near the source areas in the short term (several years). The data from the TW40 however, indicates that the old hydro-clarifier source effluents may not have been oversatured with respect to cadmium carbonate. It is thus considered unlikely that cadmium carbonate precipitated in the vadose zone or Upper Basalt Zone aquifer downgradient from the old hydro-clarifier. As a result, the natural flushing out of cadmium solutes in this area may occur in the future since the cadmium source has been removed. The rate of which cadmium concentrations could decrease with time cannot be determined based on the available data.

7.0 SUMMARY

A hydrogeological investigation has been carried out at the Soda Springs facility of the Monsanto Industrial Chemical Company. The purpose of the investigation was to assess if past or current operations had impacted surface or subsurface water quality. The following summarizes the work program, the results and conclusions of the investigation.

7.1 Work Program

Four phases of work were carried out:

A Literature Survey - to develop a geological, hydrogeological and hydrogeochemical data base for the plant site and local area prior to undertaking detailed investigations.

Preliminary Field Studies - to expand the data base for the plant site area. The work consisted of geological reconnaissance, pump testing of the existing seven test wells and three plant production wells, geophysical logging of the existing test wells and water level monitoring of existing test wells and plant production wells.

Installation of New Wells - 31, 4 inch diameter test wells were installed to refine the understanding of the hydrogeological conditions underlying the plant site.

Additional Field Studies - these consisted of; geophysical logging of the new test wells, pump testing and/or airlift testing on the new test wells, water quality sampling of the new and existing test wells, plant production wells, off site wells, springs and effluent and water level measurements in all the test wells.

7.2 Results of Investigation

7.2.1 Geology

- The plant site is located overlying silty clays which inturn overlie Pleistocene basalts of the Blackfoot Lava Field. The basalts are interbedded with cinder zones, silts, sands and gravels. The basalts lie uncomformably over sandstones and conglomerates of the Salt Lake Formation. A hinge fault crosses the plant site striking northwest - southeast. The fault exhibits west side down relative displacement of between 20 to 80 ft. Subsidiary subparallel faulting may also be present west of the hinge fault.

7.2.2 Drilling and Well Completion

- Borehole instability, associated with the unconsolidated sedimentary basalt interbeds, was a frequent problem during the drilling program. The telescoping technique was found to be the most suitable method of controlling unstable zones.

- Most groundwater was produced from cinder or weathered zones no more than 50 ft below the water table.

- During drilling, measurements of groundwater fluoride concentrations and specific conductance were useful in distinguishing different groundwater types.

- Of the 31 test wells completed, three test wells (TW24, TW25 and TW32) appear to be affected by grout invasion. All other test wells were succcessfully completed.

7.2.3 Geophysics

- The natural gamma log, (run in open hole) was found to be the most useful log for determining lithostratigraphic correlations in the basalt sequence. The resistivity log, when used in conjunction with lithology, provided an indication of basalt interbed zones.

7.2.4 Hydraulics

- Pump testing of the existing test wells indicates a range in transmissivity from 0.5 to 9200 ft^3/day/ft for the screened zones. Generally, these values indicate that the existing test wells range in their ability to produce water from very poor to good. The data from TW3 and TW4 indicate that these test wells are in direct hydraulic communication. Data from TW5 and TW6 appears to indicate that these test wells may be in direct hydraulic communication but the data is inconclusive.

- Pump testing of the new test wells TW9 and TW10 indicates transmissivities of 7 ft^3/day/ft and 2450 ft^3/day/ft. The vertical hydraulic conductivity of the basalt is considered greater than 4.7×10^{-5} ft^2/day/ft. This generally indicates a relatively slow rate of water movement vertically between different water producing zones. Regional pump testing in the southern plant site area indicates that the basalt sequence is either anisotropic (a spatial change in aquifer parameters) or that hydraulic barriers exist (faults or a pinching out of the aquifer).

- The plant production well testing indicates that the hydraulic conductivity of the basalt interbed zones could range from 2.2×10^2 to 2.5×10^4 ft^2/day/ft. These are very high values and indicate that the plant production wells are able to produce large amounts of water. The storativity of the system ranges between 3.1 to 5.4×10^{-5}. This indicates that the system is rigid and does not compress when water is removed.

7.2.5 Hydrochemistry

- The water quality analysis show that a number of wells and springs have concentrations of fluoride, cadmium and selenium in excess of the EPA recommended drinking water standards. Some wells and springs also record sulfate and chloride concentrations above the recommended levels. Concentrations of vanadium are also present in some ground waters.

- o The QA/QC program indicates that sulfate analyses are valid but not exact, while the arsenic analyses may not be valid at low concentrations. With the exception of cadmium and selenium concentrations, which may be inaccurate at low concentrations, the accuracy and precision of the other parameters analysed is acceptable.

- o Two ground water types, soda water and fresh water are recognized. In general, only the fresh water contains elevated concentrations of fluoride, cadmium, selenium, sulfate, chloride and vanadium.

7.2.6 Water Level Monitoring

- o Earth tide induced responses were observed in test wells completed greater than 100 ft below the water table. A storativity of 5 x 10^{-5} was calculated for the hydrogeological system based on those responses. This is similar to that calculated from the testing of the plant production wells and is indicative of a rigid hydrogeological system.

- o In general, there is a negligable difference in the potentiometric elevation between the upper two test wells at a particular well nest site completed within the Upper Basalt Zone. There is a measureable vertical component of hydraulic gradient between the Upper and Lower Basalt Zones. The vertical component is generally upwards along the southern plant site boundary and downwards in the central plant site area.

7.3. Hydrogeological Model

7.3.1 Hydrostratigraphy

- o Four hydrostratigraphic zones have been identified: a shallow Surficial Deposit Zone; an Upper Basalt Zone; a Lower Basalt Zone; and the Salt Lake Zone. Each zone is characterized by a combination of geology, hydrogeology and geochemistry. There is limited data from both the Surficial Deposit Zone and the Salt Lake Zone.

7.3.2 Ground Water Flow Directions

- Ground water flow in the Upper Basalt Zone is influenced by faulting and/or regional hydrogeological conditions and pumping of the plant production wells. Both the hinge fault and the postulated subsidiary fault which strike northwest- southeast, appear to act as "barriers" to ground water flow. The presence of a regional ground water discharge area south west of the plant site appears to have a similar effect as a "barrier" boundary. The ground water flow direction is generally to the south or southeast parallelling the geological structure. Estimated ground water flow rates range from about 20 to 2000 ft/day in this zone. The pumping of the plant production wells creates a cone of depression in the central plant site area intercepting ground water flowing from the north, northeast and east of the plant site. The Upper Basalt Zone is recharged by precipitation, underflow from the north and east and leakage from the underlying Basalt Zone over the southern and northern parts of the plant site. Discharge from the Upper Basalt Zone is by pumping of the plant production wells and also southwards via underflow. Plant production well pumping also appears to have induced downward leakage from the Upper Basalt Zone into the Lower Basalt Zone over the central portions of the plant site. This ground water may then be drawn towards the pumping wells in the Lower Basalt Zone and discharged from the system.

- Ground water flow in the Lower Basalt Zone is also influenced by faulting and/or a regional ground water discharge zone and the pumping of the plant production wells. The faults and discharge zone act as "barriers" to ground water flow. The ground water flow direction is similar to that of the Upper Basalt Zone; southeastwards over much of the southern plant site area and southwestwards over the northeast plant site quadrant. Estimated ground water flow rates in this zone range from 0.6 to 30 ft/day—an order of magnitude less than in the Upper Basalt Zone. The Lower Basalt Zone is recharged by leakage from the underlying Salt Lake Zone or deeper lying basalts and by leakage from the overlying Upper Basalt Zone in the central plant site area. The pumping of the plant production wells appears to be responsible for the downward leakage from the Upper Basalt Zone to the Lower Basalt Zone in the central plant site area. It appears that the leakage from the Upper Basalt Zone may eventually flow towards the plant production wells in the Lower Basalt Zone and be discharged from the system. The Lower Basalt Zone also discharges southwards via underflow and upwards to the Upper Basalt Zone over the southern portions of the plant site.

7.3.3 Ground Water Quality

- Ground water from the Upper Basalt Zone is fresh to slighlty brackish except in the southwest plant site corner, west of the subsidiary fault or ground water discharge area, where the water is sodic. The fresh to slightly brackish water contains concentrations of fluoride, cadmium, selenium, sulfate, chloride and vanadium above background levels in certain areas of the plant site. The sodic ground waters of the Upper Basalt Zone generally do not contain concentrations of the above ions in excess of background concentrations. Ground water from the Lower Basalt is fresh in the south east and eastern areas of the plant site, soda in the southwest and northwest plant site areas and slightly brackish to sodic in the west central plant site area. The Lower Basalt Zone ground waters in the west central plant site area contain above background concentrations of chloride and sulfate and questionable levels for fluoride, cadmium and selenium (may be due to poor test well completion). Lower Basalt Zone ground waters from the southeast plant site corner also contain chloride and sulfate levels in excess of background concentrations. The sodic Lower Basalt Zone ground waters from the southwest and northwest plant site corners and the fresh ground waters from the eastern plant site do not contain concentrations of either fluoride, cadmium, selenium, chloride or sulfate in excess of background concentrations.

7.4 Water Quality Impacts

7.4.1 Upper Basalt Zone

- Within the Upper Basalt Zone flow system that is bounded to the east by the hinge fault and to the west by the subsidiary fault or ground water discharge zone, a plume containing fluoride, cadmium, selenium, sulfate chloride and vanadium ions is present. The fluoride plume, with concentrations in excess of 5 mg/l extends south southeastwards from the old underflow solids ponds over a width of about 1500 ft to at least Calf and Mormon Springs. The cadmium, chloride and vanadium plumes appear to be restricted to the plant site area while the selenium and sulfate plumes appear to extend south of the southern plant site boundary.

- To the northeast of the hinge fault fluoride, cadmium, selenium, chloride, sulfate and vanadium plumes are present. The plumes originate in the area of the northwest pond and old hydro-clarifier. The fluoride, cadmium, selenium, chloride and sulfate plumes extend southeastwards to the plant production wells. The vanadium plume is only present immediately southeast of the northwest pond and old hydro-clarifier. None of the above ions are present immediately southeast of the plant production wells. It appears that the plant production wells create a local cone of depression intercepting the southeasterly migration of these ion plumes.

- A chloride, sulfate and vanadium plume is also present in the southeast plant site area. The plume appears to originate from an area to the east of the Monsanto plant site. The plume is bounded to the west by the hinge fault which appears to direct the plume in a southerly direction.

- The Upper Basalt Zone ground waters in the southwest plant site area contain slightly elevated concentrations of fluoride and chloride. These ground waters could be affected by the mixing of ion enriched ground waters from the area east of the subsidiary fault/discharge area or be affected by leakage from the effluent pond or effluent ditch. Overall, it appears that the subsidiary fault or ground water discharge zone restricts the ion plumes from the area of the old underflow solids ponds to a relatively narrow zone in the west to south central plant site area.

7.4.2 Lower Basalt Zone

- Chloride and sulfate plumes and possibly fluoride, cadmium and selenium plumes extend southeastwards from the old underflow solids pond area. The plumes are not as extensive as those in the Upper Basalt zone and do not extend south of the southern plant site boundary. The plumes lie immediately beneath the area of the Upper Basalt Zone where high concentrations of the above ions are observed. It is believed that either the downward component of hydraulic gradient or faulty completion of TW5 may be responsible for the ion plumes in the Lower Basalt Zone.

- A chloride and sulfate plume may also be present in the southeast plant site corner. There is however data available from only one test well (TW11) and thus the extent of this plume is unknown. The plume may be associated with the chloride, sulfate and vanadium plume identified in the Upper Basalt Zone in this area.

7.4.3 Statistical Analyses

- The student "T" test results generally confirmed the source areas identified by the examination of the ion isopleth distributions. The old underflow solids pond and northwest pond locally impact ground water quality in the Upper Basalt Zone with increased concentrations of fluoride, cadmium, selenium, chloride, sulfate and vanadium. The old hydro-clarifier was a source of fluoride, cadmium, chloride and sulfate also impacting the Upper Basalt Zone ground waters. The ground water quality in the Lower Basalt Zone appears to be impacted by the old underflow solids pond or leakage associated with poor well completion at TW5.

7.4.4 Solute Mobility Fate

- Solute concentration ratios indicate that chloride, sulfate and fluoride are migrating along the flow path with similar mobilities. Cadmium and selenium are less mobile in the ground water system.

- Saturation indices indicate that the ground water in the Upper Basalt Zone is oversaturated with respect to fluorite down-gradient of the old underflow solids ponds. Fluorite equilibrium appears to be reached by the southern plant site boundary. The Upper Basalt Zone ground waters are also oversaturated with respect to fluorite immediately downgradient of the northwest pond and old hydro-clarifier. The ground waters of the Lower Basalt Zone are oversaturated with respect to fluorite at TW5. It is inferred that the source effluents are oversaturated with respect to fluorite leading to the precipitate of fluorite in the vadose zone and in the aquifer down-gradient of the source areas. Fluoride could thus be redissolved by percolating water or fluctuating ground water levels or throughflow of ground water undersaturated with respect to fluorite and remain in the ground water system in the short-term (months to several years) even if the sources are removed.

- Cadmium carbonate is undersaturated in all of the local ground waters. The Upper Basalt Zone ground waters immediately down-gradient of the old underflow solids ponds and northeast pond are close to saturation with respect to cadmium carbonate indicating that the source effluents may be oversaturated with respect to cadmium carbonate. The potential exists for the precipitation of cadmium carbonate in the vadose zone underlying these source areas. This cadmium precipitate could potentially be re-dissolved and remain in the local ground water system in the short-term (several years). The Upper Basalt Zone ground waters immediately downgradient of the old hydro-clarifier are undersaturated with respect to cadmium carbonate. It appears that the cadmium source effluents from the old hydro-clarifier were undersaturated. Therefore, since the source has recently been removed, natural flushing out of cadmium solutes may occur in the future. The rate at which cadmium concentrations could decrease with time cannot be determined based on the available data.

We trust this report is sufficient for your present needs. If you have any questions, please do not hesitate to contact us.

Yours very truly,

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GLOSSARY OF TERMS AND EXTRACT FROM "GROUND WATER RESOURCE EVALUATION" BY W.C. WALTON

Accuracy - refers to the agreement between the amount of a component measured by the test method and the amount actually present.

Aeration - the process of being supplied or impregnated with air.

Aliquot - a fractional part of a sample volume.

Alluvium - detrital deposits resulting from rivers, creeks and streams.

Anisotropy - condition having different properties in different directions.

Annulus - space between borehole casing or piezometer pipe and the borehole wall.

Aquifer - stratum or zone beneath the surface of the earth capable of producing water.

Aquitard - stratum or zone beneath the surface of the earth with low permeability to the flow of water.

Basalt - an extrusive igneous rock composed primarily of dark-colored, fine grained basic minerals. Generally forms lava flows and often exhibits columnar jointing.

Bedding - collective term for planes dividing rocks of the same or different lithology.

Bentonite - clay mineral formed from alteration of volcanic ash.

Calcareous - containing calcium carbonate.

Carboniferous - geologic time period between 345 and 280 million years ago.

Cinders - primarily uncemented, glassy and vesicular volcanic ejecta.

Clasts - individual constituents of detrital sediment produced by physical disintegration of a larger mass.

Colluvium - loose erosional deposition at the base of a slope or cliff, transported chiefly by gravity.

Conglomerate - rounded water-worn fragments of rock or pebbles cemented together by another mineral substance.

Effective Porosity	- the porosity of the rock through which is interconnected and through which flow can take place.
En-echelon	- parallel structural features that are offset like the edges of shingles on a roof when viewed from the side.
Flocele	- fine plastic chips mixed with grout used to reduce circulation loss during drilling.
Foam	- biodegradable product used to lift drill cutting from drill bit to the ground surface.
Geolograph	- instrument used to record rate of drilling penetration.
Gouge	- finely abraided material occurring between the walls of a fault, the result of grinding movement.
Graben	- a downthrown block between two parallel faults.
Hinge Fault	- fault where displacement across fault decreases towards pivot point.
Horst	- an upthrown block between two parallel faults.
Hydraulic Conductivity	- is a measure of the ease of movement of ground water through a cross-sectional area of 1 square foot of the aquifer under a hydraulic gradient of 1. In an analgous electrical network, resistors are inversely proportional to the hydraulic conductivity. Sands and gravels typically have a hydraulic conductivity on the order of 300 ft^2/day/ft while clays have a hydraulic conductivity on the order of .003 ft^2/day/ft.
Hydraulic Gradient	- rate of change of hydraulic head with distance. Analgous to the potential drop across part of an electrical circuit.
Hydraulic Head	- height of a measured water column above an established datum. Analgous to electrical potential.
Hydrograph	- graphical representation of variations in water levels in with time.
Indurated	- rendered hard by geological processes including heat, pressure and cementation.
Limestone	- a bedded sedimentary deposit consisting chiefly of calcium carbonate.

Lineaments - a conspicuous linear feature on the surface of the earth related to underlying geologic structure.

Lithology - physical character of a rock.

Matrix - fine grained material in which other coarser grains are contained.

Meteoric - originating from atmospheric weather.

Normal Fault - a fault at which the hangingwall has been depressed relative to the footwall.

Permian - geologic time periods between 280 and 225 million years ago.

Pleistocene - a division of Quaternary geologic time during which time continental glaciation occurred.

Porosity - the ratio of the aggregate volume of interstices in a rock or soil to its total volume.

Porphyritic - a textural term for igneous rocks in which larger crystals are set in a finer ground mass.

Precision - is the degree of agreement of repeated measurements, usually expressed in terms of the scatter of test results about the mean of all the determinations.

Quality Assurance - assuring the reliability of monitoring and measurement data.

Quality Control - procedure for obtaining prescribed standards of performance in monitoring and measurement processes.

Quaternary - the geologic time period between the present and 2 million years ago.

Rhyolite - a fine grained to glassy acidic volcanic rock mineralogically similar to granite. It is viscous and does not form extensive flows around volcanic vents.

Rugosity - roughness and irregularity of borehole walls.

Sandstone - a cemented or otherwise compacted detrital sediment composed predominantly of quartz grains.

Scarp - a cliff or steep slope of some extent along the margin of a plateau.

Scoriaceous - "frothy" appearance in rock containing abundant vesicles.

Slickensides - polished and striated surfaces that result from friction along a fault plane.

Spike Sample - sample with known quantities of particular ions added.

Split Sample - sample divided into two parts for analysis.

Stiff Diagram - graphical representation of ion balance and concentrations in a ground water sample.

Storativity - volume of water that an aquifer releases from storage per unit surface area of the aquifer per unit decline in the component of hydraulic head normal to that surface. In an electrical network, capacitors store electrostatic energy in a manner analgous to the storage of water in an aquifer.

Stratigraphy - the study of stratified rocks, their character, correlation and sequence in tiem.

Strike - the direction or bearing of a horizontal line in the plane of an inclined stratum, joint, fault or other structural feature.

Tertiary - geologic time period between 65 million years ago and the present.

Thrust Fault - a reverse fault that is characterized by a low angle of inclination with reference to a horizontal plane.

Transmissivity - indicates the capacity of an aquifer to transmit water through its entire thickness and is equal to the hydraulic conductivity multiplied by the saturated thickness of the aquifer, in feet. Transmissivity is defined as the rate of flow of water, through a vertical strip of the aquifer 1 foot wide and extending the full saturated thickness under a hydraulic gradient of 1 foot per foot. In an electrical network, transmissivity is analgous to the reciprocal of electrical resistance (1/R).

Travertine - a calcium carbonate of light color, usually concretionary and compact, deposited from solution in ground and surface water.

Tremie - continuous extrusion of grout from a pipe as the pipe is withdrawn gradually from the hole.

Tuff - a solidified volcanic ash composed of crystals and fragments of various sizes.

Unconformity - an interruption in the deposition of sediments, or an erosional surface separating younger strata from older rocks.

Vesicular - rock texture with small spherical and ellipsoidal cavities produced by gas bubbles during lava solidification.

Zeolites - a group of hydrous aluminosilicate minerals characterized by their ease of ion exchange.

CHAPTER 2

GROUNDWATER MOVEMENT, STORAGE, EXPLORATION, AND DATA

Most rocks contain numerous open spaces, called *interstices*, in which water may be stored and through which water can move. Water that exists in the interstices of rocks is called *subsurface water* (Meinzer, 1959); that part of subsurface water in interstices completely saturated with water is called *groundwater*. Subsurface water in interstices above the zone of saturation in the zone of aeration where interstices are only partially saturated with water is called *vadose water*. The zone of aeration is subdivided into the soil water zone, the intermediate zone, and the capillary zone. The *soil water zone* consists of soil and other materials near the surface which discharge water into the atmosphere by evapotranspiration. The *capillary zone* extends immediately above the zone of saturation to the limit of capillary rise of water. The *intermediate zone* lies between the soil water and capillary zones (*capillary fringe*). This book is primarily concerned with groundwater.

An *aquifer* is a saturated bed, formation, or group of formations which yields water in sufficient quantity to be of consequence as a source of supply. An *aquitard* is a saturated bed, formation, or group of formations which yields inappreciable quantities of water to drains, wells, springs, and seeps compared to an aquifer but through which appreciable leakage of water is possible. An *aquiclude* is a saturated bed, formation, or group of formations which yields inappreciable quantities of water to drains, wells, springs, and seeps and through which there is inappreciable movement of water. A formation may be classified as an aquifer in one area but only as an aquitard or aquiclude in a different area depending upon the availability of groundwater. An aquifer serves as a transmission conduit and storage reservoir. It transports water from recharge areas to surface bodies of water, wetlands, springs, areas of evapotranspiration and wells and other water-collecting devices. As a storage reservoir, an aquifer provides reserve water for use during periods when withdrawals exceed recharge. The quantities of water available in storage in some productive aquifers are so great that in places large withdrawals over a period of years fail to produce marked evidence of depletion.

An *unconfined aquifer* is one in which groundwater possesses a free surface open to the atmosphere. The upper surface of the zone of saturation is called the *water* *table*. Changes in the stage of the water table correspond to changes in the thickness of the zone of saturation; when the water table declines, gravity drainage of interstices occurs. In most places there is only one water table, but in some localities because of the presence of aquitards or aquicludes there may be perched aquifers with additional water tables.

An *artesian aquifer* is one in which groundwater is confined under pressure by overlying and underlying aquitards or aquicludes and water levels in wells rise above the top of the aquifer. Artesian aquifers are classified as leaky or nonleaky depending upon whether groundwater in the aquifer is confined by aquitards or aquicludes. Water levels in wells tapping artesian aquifers sometimes rise above the surface to cause wells to flow. Rises and falls of the water levels in wells tapping artesian aquifers correspond to changes in the pressure of the water. The imaginary surface to which water rises in wells tapping artesian aquifers is called the *piezometric surface*. When water is released from storage by the compaction of the aquifer and its associated beds and by expansion of the water itself, while the interstices remain saturated, the piezometric surface is lowered. An artesian aquifer becomes an unconfined aquifer when the piezometric surface declines below the top of the aquifer. The piezometric surface may rise to stages above or below water tables depending upon whether the vertical movement of water is from or into the aquifer. Examples of unconfined and artesian aquifers are shown in Fig. 2.1.

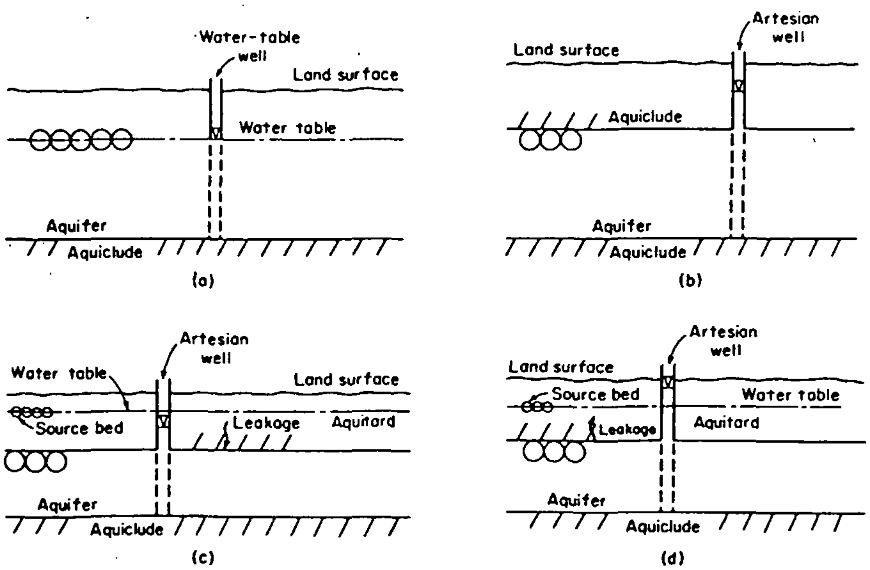


Fig. 2.1 Diagrammatic examples of unconfined aquifer (*a*), nonleaky artesian aquifer (*b*), leaky artesian aquifer with downward leakage (*c*), and leaky artesian aquifer with upward leakage (*d*). (*Drawn by W. C. Walton.*)

2.1 Interstices

Differences in the number, size, shape, interconnection, and arrangement of the interstices of aquifers, aquitards, and aquicludes result from the great diversity of geologic processes by which rocks were produced and later modified. Most interstices are small and interconnected, some are cavernous in size, and others are small and largely isolated so that there is little opportunity for movement of water from one interstice to another. The nature of interstices is determined by the geologic framework of rocks, and an orderly description of the geology and geologic history of an area is essential for an understanding of the movement and storage of groundwater.

The interstices of rocks may be divided into two groups, original and secondary (Meinzer, 1959). *Original interstices* came into existence when the rocks were formed and can be subdivided into those of sedimentary origin and those of igneous origin. *Secondary interstices* are the result of processes by which rocks were modified after coming into existence and largely comprise joints and other fracture and solution openings. Original interstices consist of the spaces between adjacent fragments of sedimentary rock and small cavities or inclusions, within crystals and small intercrystal spaces developed in igneous rocks during their congealing. Most consolidated rocks are broken by joints cutting the rocks in various directions and extending to varying distances and depths. These secondary interstices, produced chiefly by shrinkage, pressure, and deformation of rocks, commonly vary in number and size. Joints often intersect one another, frequently have no regularity of spacing, and tend to become tighter and spaced farther apart with depth. Secondary interstices are also produced by the chemical decomposition of rocks and the solution and subsequent removal of the soluble products, or by the solution and removal of soluble rocks. The removal of the calcareous cement from the original interstices of a sandstone or the removal of soluble material such as limestone results in abundant secondary openings in many areas. In some consolidated sedimentary rocks, the original interstitial spaces are likely to decrease with depth; most deep wells have encountered few interstices below a depth of a mile. In many igneous rocks, most interstices are found within a few hundred feet of the surface. Several types of interstices are shown in Fig. 2.2.

The shape of interstices and the degree of their interconnection are extremely complex. In order to lay the foundation for a mental picture of interstitial space, the interstitial fabric of the simple geometry of aggregates of well-rounded fragments of rock of the same diameter will be described. No rocks consist exclusively of spheres of one size, but some well-sorted sand deposits probably develop interstitial patterns similar to those developed by packing of perfect spheres. The theoretical treatment of such aggregates is worthwhile if the profound modifications of interstices caused by irregularity in shape and degree of assortment of grains of rocks are kept in mind.

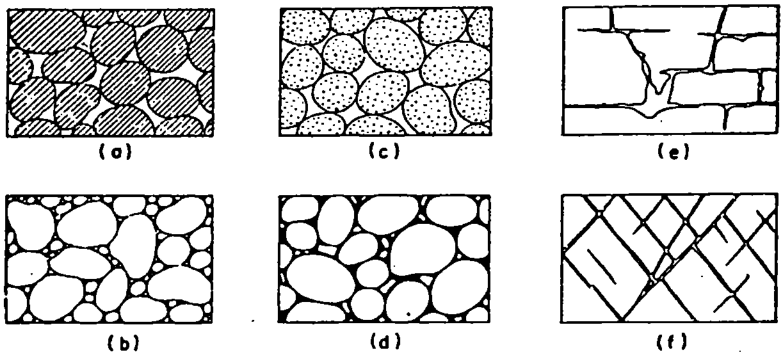


Fig. 2.2 Several types of interstices and the relation of rock texture to porosity. (*a*) Well-sorted sedimentary deposit having high porosity; (*b*) poorly sorted sedimentary deposit having low porosity; (*c*) well-sorted sedimentary deposits consisting of fragments of rock that are themselves porous, so that the deposit has a very high porosity; (*d*) well-sorted sedimentary deposit whose porosity has been diminished by the deposition of mineral matter in interstices; (*e*) rock rendered porous by solution; and (*f*) rock rendered porous by fracturing. (*From Meinzer, 1959.*)

It has been shown by Graton and Fraser (1935) that the least compact arrangement of spheres is that of a cubical array of spheres and the most compact arrangement is that of a rhombohedral array. The porosity of the cubical array is 47.6 percent and the porosity of the rhombohedral array is 26.0 percent. Figure 2.3 shows the packing of spheres in the two arrays and the resulting interstitial volumes.

The most stable array of spheres is rhombohedral. It might be expected that under moderate agitation spheres would assume the most stable array and hence the assemblage of least porosity. However, under natural conditions the required perfection in packing is confined to a limited number of grains, and beyond this point random packing results. In natural assemblages agitated to induce compact packing, groups of spheres packed in orderly arrays are separated by boundaries in which random packing occurs and where the porosity is even higher than that for cubic packing. These zones are maintained because of the bridging of groups of particles under pressures less than the crushing strength of the particles.

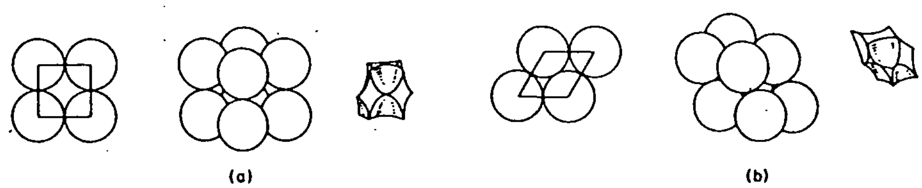


Fig. 2.3 Packing of spheres and interstitial volumes. (*a*) Least compact arrangement; (*b*) most compact arrangement. (*Drawn by W. C. Walton.*)

2.2 Porosity

The *porosity* of a rock is a measure of the interstitial space of the rock and is expressed quantitatively as the percentage of the total volume of rock occupied by interstices (Meinzer, 1959). Figure 2.2 shows several types of interstices and their relation to rock texture. Representative porosity ranges for selected rocks are given in Table 2.1. In general, a porosity greater than 20 percent is considered large, a porosity between 5 and 20 percent is considered medium, and a porosity less than 5 percent is considered small. The highest porosity known is 80 to 95 percent, which has been reported for freshly deposited alluvium of the Mississippi delta.

TABLE 2.1 REPRESENTATIVE POROSITY RANGES FOR SELECTED ROCKS

Rocks	*Porosity,* %
Clay	45–55
Sand	35–40
Gravel	30–40
Sand and gravel	20–35
Sandstone	10–20
Shale	1–10
Limestone	1–10

The porosity of a sedimentary deposit depends chiefly on the shape and arrangement of its constituent particles, the degree of assortment of its particles, the cementation and compacting to which it has been subjected since its deposition, the removal of mineral matter through solution by percolating waters, and the fracturing of the rock, resulting in joints and other interstices. In well-sorted and well-rounded deposits, the size of grains has no influence on porosity; thus, a deposit of boulders may have the same porosity as a deposit of clay. The porosity of many deposits is increased by the irregular angular shapes of its constituent grains. Porosity decreases with increases in the variety of size of grains; small grains fill interstices between large grains. Meinzer (1959) outlined several methods for determining porosity.

2.3 Specific Yield

Not all the water in the interstices of a saturated rock can be withdrawn through wells, drains, springs, or seeps. A part of the water is retained in interstices largely by the forces of molecular attraction, adhesion, and cohesion. The attraction between the walls of interstices and the adjacent molecules of water is called *adhesion;* the attraction between adjacent molecules of water is called *cohesion.* The walls of interstices retain a film of water by adhesion and some water is retained in detached

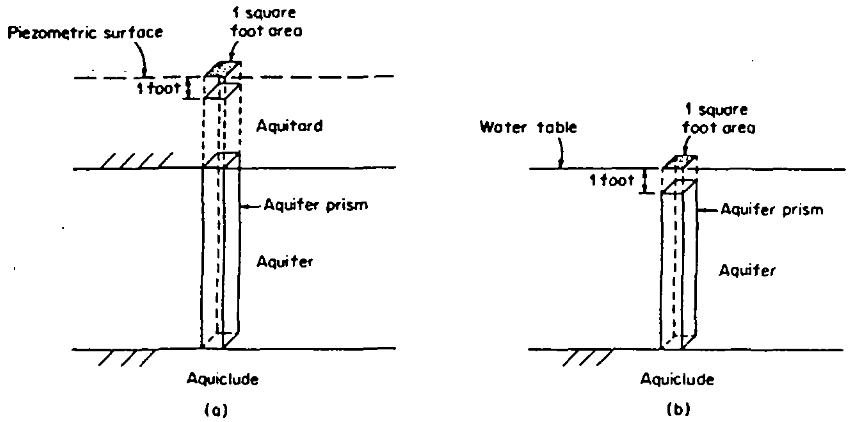


Fig. 2.4 Diagrammatic representation of coefficient of storage. (*a*) Artesian condition; (*b*) water-table condition. (*After Ferris et al., 1962.*)

interstices. The amount of water retained varies directly as the aggregate surface of the interstices and indirectly as the size of the interstices; thus retention is greatest in rocks having small interstices. The amount of water retained in interstices also depends on the time of drainage; on the temperature and mineral composition of groundwater which affect its surface tension, viscosity, and specific gravity; and on various physical relations of the rock.

The *specific yield* of a rock is a measure of the water-yielding capacity of the rock and is expressed quantitatively as the percentage of the total volume of rock occupied by the ultimate volume of water released from or added to storage in a water-table aquifer per unit (horizontal) area of aquifer and per unit decline or rise of the water table (see Fig. 2.4*b*). The *specific retention* of a rock is a measure of the water-retaining capacity of the rock and is expressed quantitatively as the percentage of the total volume of rock occupied by groundwater that will be retained in interstices against the force of gravity. Representative specific-yield ranges for selected rocks

TABLE 2.2 REPRESENTATIVE SPECIFIC YIELD RANGES FOR SELECTED ROCKS

Rocks	*Specific yield,* %	
Clay	1–10	.01 – .1
Sand	10–30	
Gravel	15–30	
Sand and gravel	15–25	.15 – .25
Sandstone	5–15	
Shale	0.5–5	
Limestone	0.5–5	

are given in Table 2.2. The porosity of a saturated rock is equal to the sum of specific yield and the specific retention. Meinzer (1959) outlined several methods for determining specific yield.

For most rocks, gravity drainage of interstices is not instantaneous and the water-yielding capacity increases at a diminishing rate as the time of drainage increases, gradually approaching the specific yield. *Gravity yield* has been defined as the percentage of the total volume of rock occupied by groundwater that will drain under the action of gravity during a given period of drainage (see Rasmussen and Andreasen, 1959).

2.4 Coefficients of Storage, Permeability, and Transmissibility

The *coefficient of storage* S of an aquifer has been defined as the volume of water the aquifer releases from or takes into storage per unit surface area of the aquifer per unit decline or rise of head. In Fig. 2.4, the volume of water released from storage in the aquifer prism divided by the product of the prism's cross-sectional area and the change in head results in a dimensionless number which is the coefficient of storage. Under water-table conditions, the coefficient of storage is equal to the specific yield, provided gravity drainage is complete. The coefficient of storage of water-table aquifers ranges from about 0.02 to 0.30. Although rigid limits cannot be established, the storage coefficients of artesian aquifers may range from about 0.00001 to 0.001.

Permeability is a measure of the ease of movement of groundwater through aquifers and aquitards. The *field coefficient of permeability* of an aquifer, P, has been defined as the rate of flow of water, in gallons per day, through a cross-sectional area of 1 square foot of the aquifer (see opening A, Fig. 2.5) under a hydraulic gradient of 1 foot per foot at the prevailing temperature of the water. A related term, the *coefficient of transmissibility* T, indicates the capacity of an aquifer to transmit water through its entire thickness and is equal to the coefficient of permeability multiplied by the saturated thickness of the aquifer, m, in feet. The coefficient of transmissibility is defined as the rate of flow of water, in gallons per day (gpd), through a vertical strip of the aquifer (see opening B, Fig. 2.5) 1 foot wide and extending the full saturated thickness under a hydraulic gradient of 1 foot per foot at the prevailing temperature of the water. The rate of vertical leakage of groundwater through an aquitard is dependent upon the permeability of the aquitard. The *aquitard field coefficient of permeability* P' is defined as the rate of vertical flow of water, in gpd, through a horizontal cross-sectional area of 1 square foot of the aquitard (see opening C, Fig. 2.5) under a vertical hydraulic gradient of 1 foot per foot at the prevailing temperature of the water. Some authors use the terms *hydraulic conductivity* ($K = k\gamma/\mu$), *permeability* (k), *transmissivity* ($T = KD$), and *storativity* (ζ).

Laboratory coefficients of permeability P_L and P'_L may be computed by adjusting the field coefficients to equivalent values for the standard temperature of 60°F. The

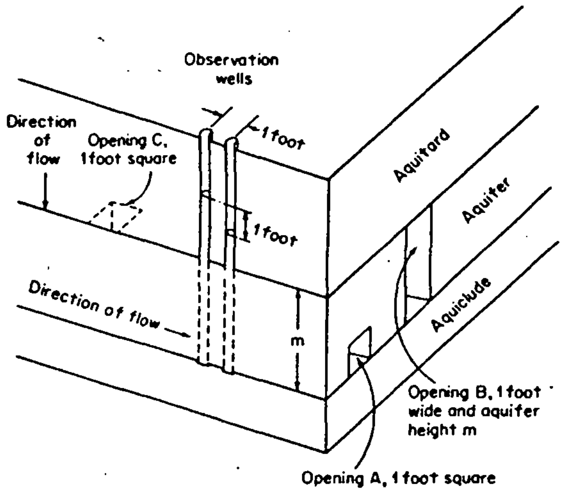


Fig. 2.5 Diagrammatic representation of coefficients of permeability and transmissibility. (*After Ferris et al., 1962.*)

relation between field and laboratory coefficients may be expressed as

$$\frac{P_L \text{ or } P'_L}{P \text{ or } P'} = \frac{\mu}{\mu_{60}} \tag{2.1}$$

where μ is the dynamic viscosity of water at the field temperature and μ_{60} is the viscosity of water at 60°F. Laboratory coefficients should be used to compare the permeabilities of aquifers and aquitards at different locations because field coefficients may vary from place to place due to variations in temperature. Representative permeability ranges for selected rocks are given in Table 2.3.

TABLE 2.3 REPRESENTATIVE PERMEABILITY RANGES FOR SELECTED ROCKS

Rocks	*Permeability, gpd/sq ft*
Clay, silt	0.001–2
Sand	100–3,000
Gravel	1,000–15,000
Sand and gravel	200–5,000
Sandstone	0.1–50
Shale	0.00001–0.1

2.5 Water-yielding Properties, Stratigraphy, and Structure of Rocks

The rocks of the earth may be divided into two large classes: (1) the consolidated rocks, or bedrocks, and (2) the unconsolidated materials. With respect to their origin, the rocks can be divided into three classes (Meinzer, 1959): (1) igneous rocks, which are produced by the cooling and solidification of molten materials; (2) sedimentary rocks, which are produced by the deposition of materials weathered from older rocks, derived from the remains of animals and plants, or precipitated out of solution in water; and (3) metamorphic rocks, which are produced by the profound alteration of other rocks, chiefly through the agencies of heat and pressure.

Unconsolidated deposits of sand and gravel are the most important aquifers; probably more than 90 percent of all groundwater pumped in the conterminous United States comes from sand and gravel. The types of occurrence of these aquifers may be grouped as: watercourses, abandoned or buried valleys, plains and intermontane valleys (Thomas, 1952). *Watercourses* consist of a stream channel together with the groundwater in alluvium that underlies the channel and forms the bordering flood plains. Wells in watercourses are readily recharged by infiltration of water in the stream channel. In recent years, groundwater supplies recharged by induced infiltration of surface water have been extensively developed. Where the alluvium has a high permeability, watercourses offer excellent opportunities for large groundwater supplies, whereas at places where the alluvium is predominantly of fine texture, watercourses will yield only meager supplies. The distribution of clay, silt, sand, and gravel within river valleys is exceedingly complex in detail. The relative thickness of the coarse and fine units depends on the type of sediments carried by the river and on the geologic history of the river at the point of interest. Moderate well yields of 10 to 50 gallons per minute (gpm) can be obtained from almost all watercourse deposits. Much larger yields of 100 to 2,000 gpm are also common where the permeable zones total at least 10 feet and the saturated zone in the alluvium is at least 40 feet thick.

Abandoned or buried valleys are no longer occupied by the stream that formed them. Some buried-valley deposits have thicknesses and areal extent much greater than existing stream valleys; other valley deposits are buried and do not form a part of the present drainage system. Although the permeability of materials in abandoned or buried valleys is as high as that in watercourses, the recharge is generally much less than recharge to watercourse deposits. Many valleys were buried or abandoned during the Pleistocene ice age. Buried and abandoned valleys are numerous in glaciated areas and in valleys of streams that drained ice sheets.

Great Plains flank highlands or mountains that were the source of the sediments. Stream-deposited sand and gravel occur beneath the plains in broad belts. Sand and gravel underlie parts of Coastal Plains where formations are partly marine and partly fluviatile in origin. Aquifers of these plains are recharged directly from precipitation and from streams. Many stratigraphic units along Coastal Plains grade oceanward from partly alluvial deposits into entirely marine units. This gradation is accompanied by a tendency for the sediments to become progressively finer grained. The bulk of the sediments are clays and silts. Coastal Plains vary in size from small isolated valley deposits that grade inland into normal stream deposits to vast, almost featureless plains that fringe hundreds of miles of the coasts bordering the Arctic and Atlantic Oceans.

In basins bordered by mountain ranges occur tremendous volumes of unconsolidated deposits including sand and gravel. The sand and gravel derived by erosion of mountains underlying intermontane valleys yield more than half of all the water pumped from wells in the conterminous United States. There is some recharge directly from precipitation, but generally most recharge is by seepage from streams into the alluvial fans lying between the base of mountains and the basin floors. Subsurface flow through the walls of the mountains into intermontane valley deposits is also appreciable. The storage of these aquifers is very large in comparison to annual recharge in the arid regions.

About 30 percent of the land surface of the earth has been covered by glacial ice during the past million years. At present, 10 percent of the land surface is covered. Glacial till covers several million square miles of the earth's surface, yet relatively few wells draw their supplies directly from the till. Of the wells drawing water from till, most of them probably obtain their water from joints or small sand lenses within the till. A number of wells in mountain valleys probably draw water from coarse-grained till.

Eolian deposits (formed by the wind) are far less abundant than either stream or glacial deposits. The actual volume of eolian material encountered in subsurface exploration is hard to evaluate because distinctive textural and structural features are seldom recognized in drilling cuttings. Almost certainly many silts and sands assumed to be alluvial or lacustrine are actually eolian. Eolian deposits can be divided into two types, loess and dune sand. Loess is not commonly an aquifer because of its low permeability and because where its permeability is the highest it is usually in high topographic positions where subsurface drainage is efficient. If loess overlies impermeable soils or consolidated rocks, stock or farm wells can be developed that will give good service except during long periods of dry weather. Aquifers of dune sand are not widely utilized because wells that prevent entrance of the loess sand are difficult to construct by standard practices. In some places active dune areas are favorable for water development because of high recharge rates, good water quality, and moderately high permeabilities.

Limestones and dolomites, constituting between 5 and 10 percent of all sedimentary rocks in the conterminous United States, vary widely in permeability. The most important aquifers are those in which secondary solution openings occur. In regions where limestone forms the land surface and extends to considerable depth, groundwater dissolves the rock and waters are hard because of dissolved mineral matter. The ultimate development of limestone terraces is a karst region with such features as sinkholes, lost rivers, large springs, and subsurface drainage. Solution openings are irregularly distributed both horizontally and vertically. Some wells may penetrate deep into limestone without yielding appreciable quantities of water; nearby wells may have large yields.

Gypsum is sufficiently soluble to develop a high permeability. Water which is hard and high in sulfate is pumped from gypsum in places.

The porosity of sandstone and conglomerate is generally much less than that of their equivalents, sand and gravel, because of the presence of cementing materials between grains. The interstices of quartzites generally are almost completely closed by cementation, and the rock yields water from joints or other secondary openings. Many sandstones are only partly cemented and yield most water from the original interstices between grains and from joints. Sandstone wells seldom have yields as high as the yields of wells in unconsolidated sand and gravel.

Shale, silt, clay, glacial till, weathered residual rocks, and poorly sorted alluvium often have high porosities but retain much water by molecular attraction and have a low permeability. They furnish small supplies to domestic wells at many places. Siliceous shale, some claystones, and most argillites will develop closely spaced joints if the rocks are near the surface. Also, if these rocks are involved in faulting, fractures that stay open at considerable depths may develop. The joints and fractures may yield small amounts of water to wells. Most commonly, however, the fine-grained rocks will be barriers to the movement of groundwater.

The volcanic rock basalt has about the same range of permeability as limestone. Permeable zones include flow breccias, porous zones between successive lava beds, lava tubes, and cracks and joints. Joints caused by cooling, lava tubes, vesicles that intersect, tree molds, fractures caused by buckling of partly congealed lava, and voids left between successive flows are some of the features that give recent andesite and basalt its high permeability. Sediments interbedded with the lava will greatly increase the average porosity of large volumes of rock that are predominantly volcanic. Both the permeability and porosity of volcanic rock tend to decrease slowly with geologic time. Pyroclastic rocks associated with lava flows are generally porous but not very permeable. Exceptions are blockly, coarse material near volcanic vents and tuffs which have been reworked by water. Pyroclastic materials generally have medium permeabilities.

Generally crystalline and metamorphic rocks, commonly occurring in mountainous areas, are poor aquifers, especially in areas where these rocks are buried beneath other rocks. Where crystalline and metamorphic rocks are the uppermost bedrock, they yield small but reliable amounts of water to wells in the upper decayed portions of these rocks extending to depths up to 100 feet. Some water occurs at depths up to 300 feet in joints to shear planes. Most wells in crystalline and metamorphic rocks yield supplies sufficient only for domestic use. The average permeability of metamorphic and plutonic igneous rocks decreases rapidly with depth.

A study of the surface and subsurface distribution of rocks and of their character, thickness, and depth below land surface is prerequisite to an understanding of the occurrence and movement of groundwater at any locality. The earth's crust consists of layers of rocks laid down one upon another and underlain or intersected in places by massive or foliated rocks. Most sedimentary rocks and some igneous and metamorphic rocks are stratified to some degree, whereas most igneous rocks form massive bodies that were intruded into or extruded through the stratified rocks. Rock formations, distinct units of the earth's crust consisting of rocks of one or more kinds, may range from a few feet to thousands of feet in thickness and occur at the surface or may be buried beneath other rocks. Formations may extend over thousands of square miles or may be limited in areal extent to less than a square mile. There may be important differences in the same formation at different horizons and in different localities.

Water wells penetrate formations deposited in a region during the geologic ages of the past; generally the youngest formation is encountered first and then successively older formations are passed through. At places, because of the occurrence of intrusive rocks, folds, faults, and thrusts, older formations may rest upon younger ones. In most places, the lowest known rocks are crystalline igneous or metamorphic rocks (basal complex) which have an eroded upper surface and are overlain by younger formations. There is great variety in the succession of conformable beds overlying the basal complex; commonly a coarse-grained formation rests unconformably on older rocks. Generally, beds of a sedimentary series become increasingly fine-grained and calcareous from the bottom upward. The thickness of most sedimentary formations consisting of layers of rocks is very small in comparison with the areal extent of the formations. The formations above or below an aquifer may be distinctive and persistent.

Formations generally are stratified; individual beds may differ in thickness, composition, and compactness. Aquifers may be interbedded with aquitards or aquicludes. Due to differences in the conditions under which deposition occurred, a stratified formation generally changes gradually in thickness and character of rock from place to place. As a rule, formations are found to become thinner and finer grained at increasing distances from the source of the sediments. These lateral gradations are of great significance with respect to the occurrence and movement of groundwater.

There is often a rapid lateral gradation in unconsolidated deposits; lenses, layers, and stringers of sand and gravel occur irregularly and give way abruptly to clays. Radical changes in thickness and character are to be expected from place to place. Extreme local variations in glacial deposits and river alluvial deposits are in striking contrast to the relatively uniform conditions of some sedimentary bedrock aquifers. Glacial till has a very chaotic structure and consists of clayey materials with highly irregular interbedded lenses or layers of sand and gravel. Outwash deposits of sand and gravel made by streams that flowed from the melting glacial ice often persist over fairly large areas and sometimes change gradually in thickness and character from place to place. Alluvium tends to be irregular in structure but often has fewer local irregularities than glacial till. Lake deposits are much better stratified than either glacial drift or alluvium. The composition of glacial deposits and alluvium and lake deposits depends largely upon the nature of the rocks which were eroded to supply the material out of which they were formed.

Rock formations are rarely horizontal; dips may be due to deposition in a sloping position or to deformation after deposition. Alluvium generally dips downstream, lake deposits dip away from shore, and lava beds dip away from vents. Because of deformation, formations may have slight inclination, or they may turn into a vertical position, or overturn. Knowledge of the dip of the formation underlying a region is necessary for the determination of the distribution of the aquifers, aquitards, and aquicludes and for the forecast of the depths to aquifers. The determination of the distribution and depth of aquifers would be relatively simple if formations everywhere had the same angle and direction of dip. However, many formations have been warped to form folds including anticlines, synclines, simple sills or monoclines, or irregular flexures. Anticlines may form ridges or structural domes; synclines may be troughs or structural basins. Formations dip in all directions away from a common center in a structural dome and from all directions toward a common center in a structural basin.

At places, rocks are separated from one another by unconformities representing intervals of time during which existing rocks eroded and perhaps were tilted, warped, or broken and practically no sediments were deposited. An unconformity shows the approximate topography of a region just before the deposition of overlying formations. The distribution of an aquifer or aquitard in formations either overlying or underlying an unconformity may be controlled largely by the intervening unconformity.

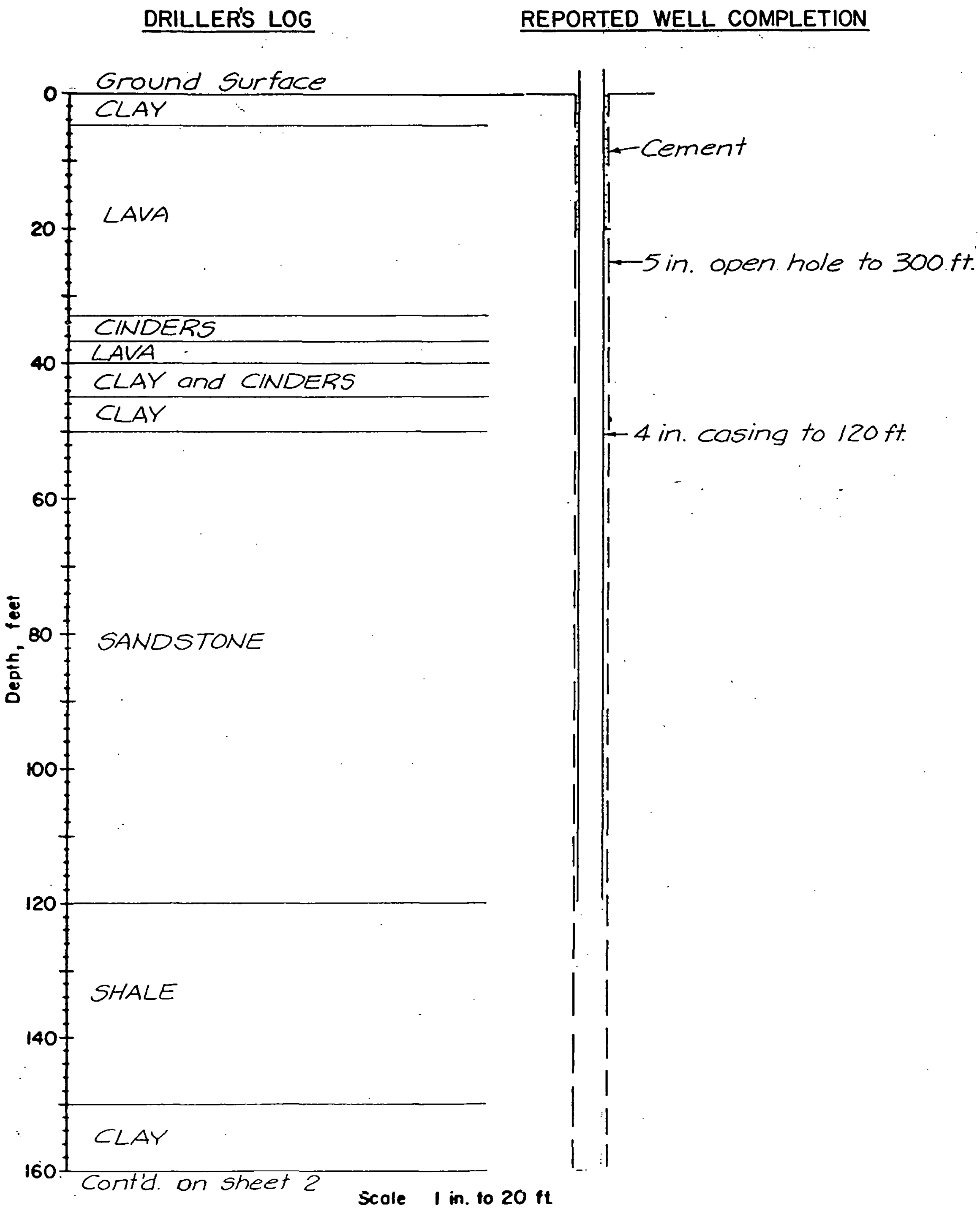
Fractures result chiefly from compression during earth movements and from rock shrinkage due to drying of sediments or cooling of igneous rocks. A joint is a natural rock fracture; if blocks of rock on opposite sides of a fracture are dislocated with reference to each other, the fracture is called a *fault*. Faults are of two kinds, normal and thrust. They differ greatly in their lateral extent, in depth, and in amount of displacement. Large faults may affect the distribution and position of aquifers and act as subsurface dams or as conduits through which deep-seated waters may escape. At places there is a fault zone called *fault breccia* containing many small parallel faults or masses of broken rock. The raised side of a fault may produce an escarpment with radical differences in the altitude and topography of the surface on opposite sides of the fault. Deposition of coarse materials may result on the downthrown side from rapid erosion of the exposed rocks on the raised side. So much erosion may occur with the lapse of geologic ages that the escarpment is obliterated. A fault may displace alternating permeable and impermeable beds so that the impermeable beds face permeable beds. There may be clayey gouge along the fault planes. The opposite sides of many faults are not everywhere pressed together; few faults are single, clear-cut breaks.

Appendix A

Test Well Lithology and Completion Details

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 1

Figure A-1



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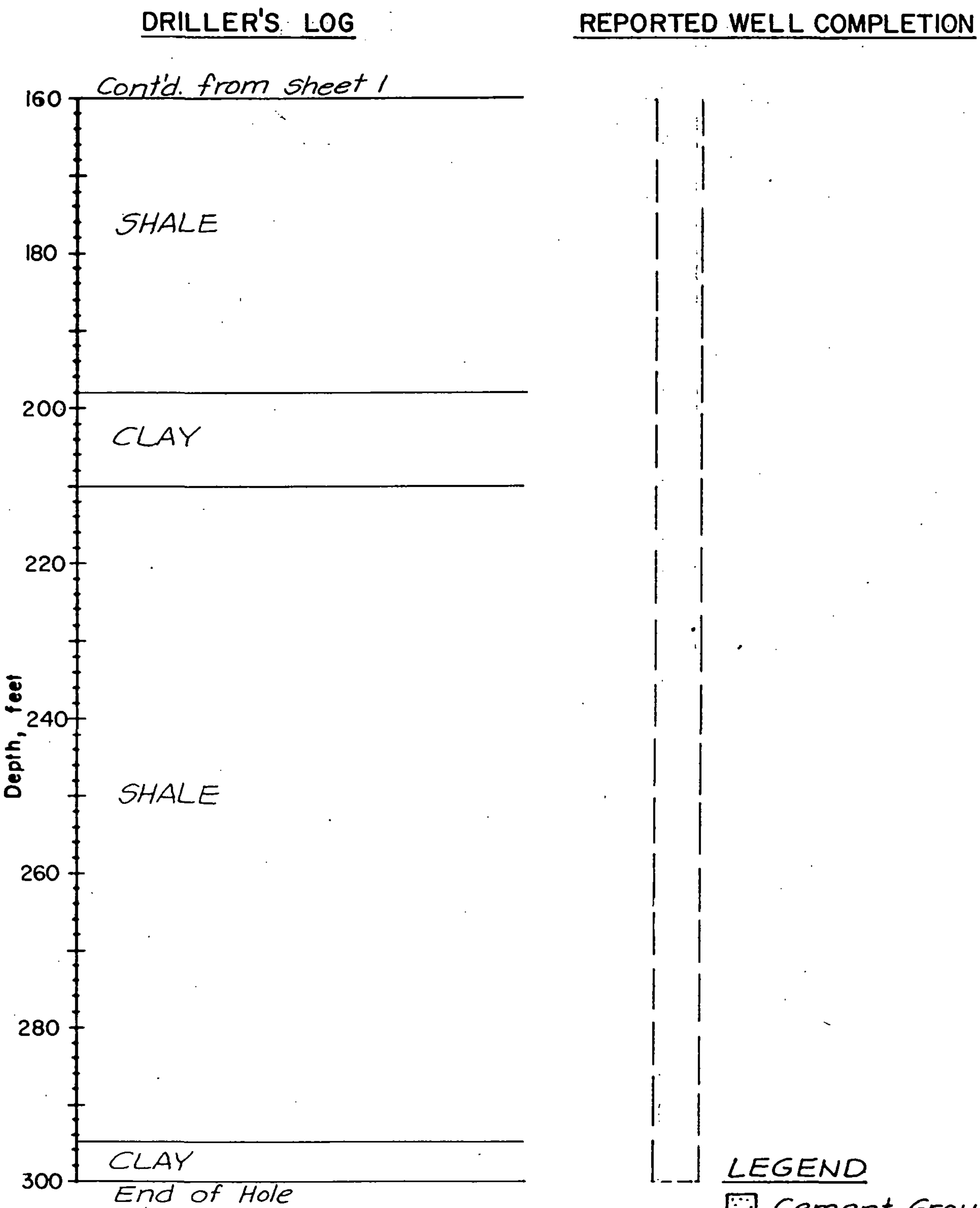
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 1

Figure



LEGEND
- Cement Grout
- Bentonite
- Gravel Backfill
- Cave
- Casing with drive shoe.

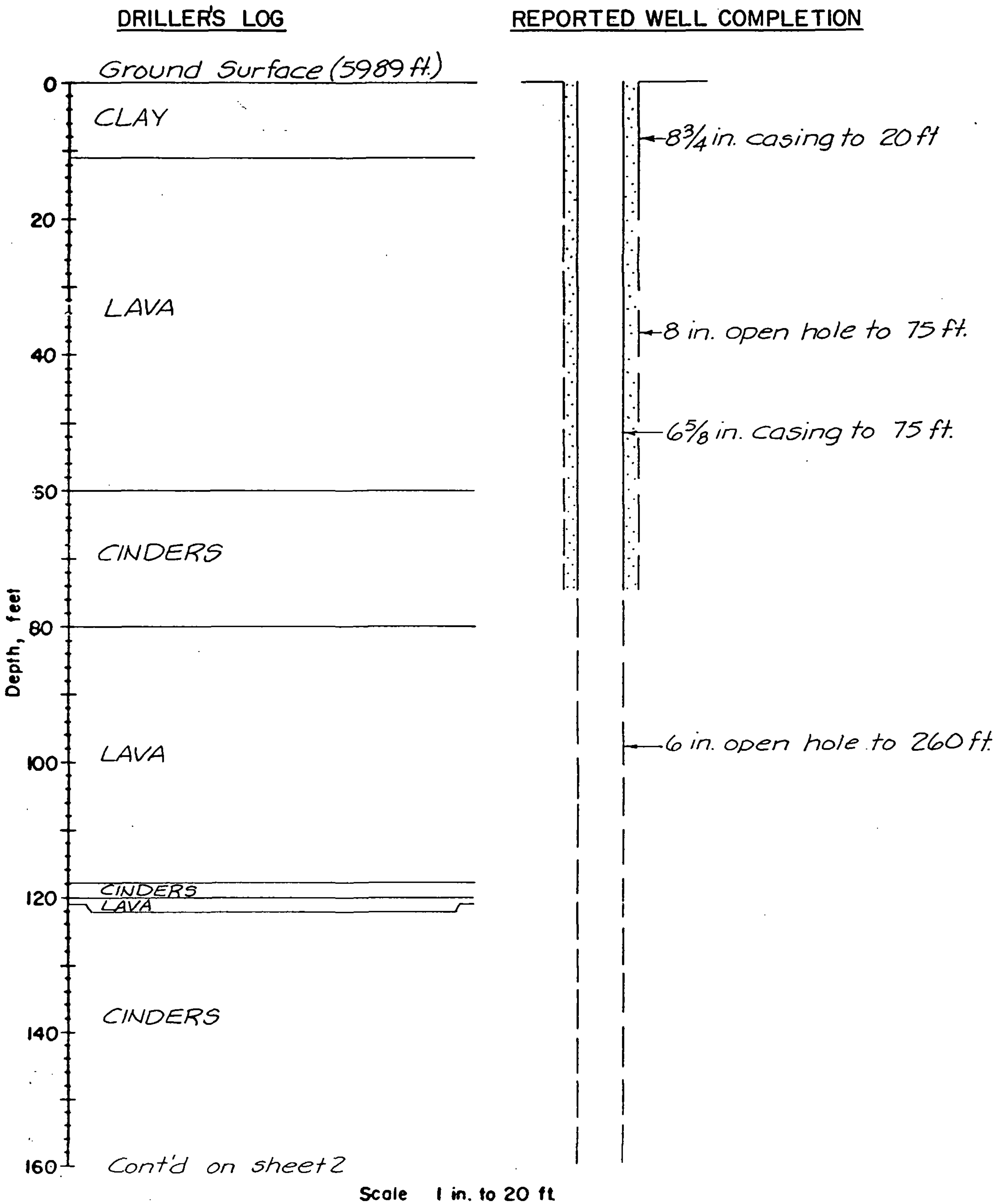
Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE ....

Golder Associates

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 2

Figure A-2

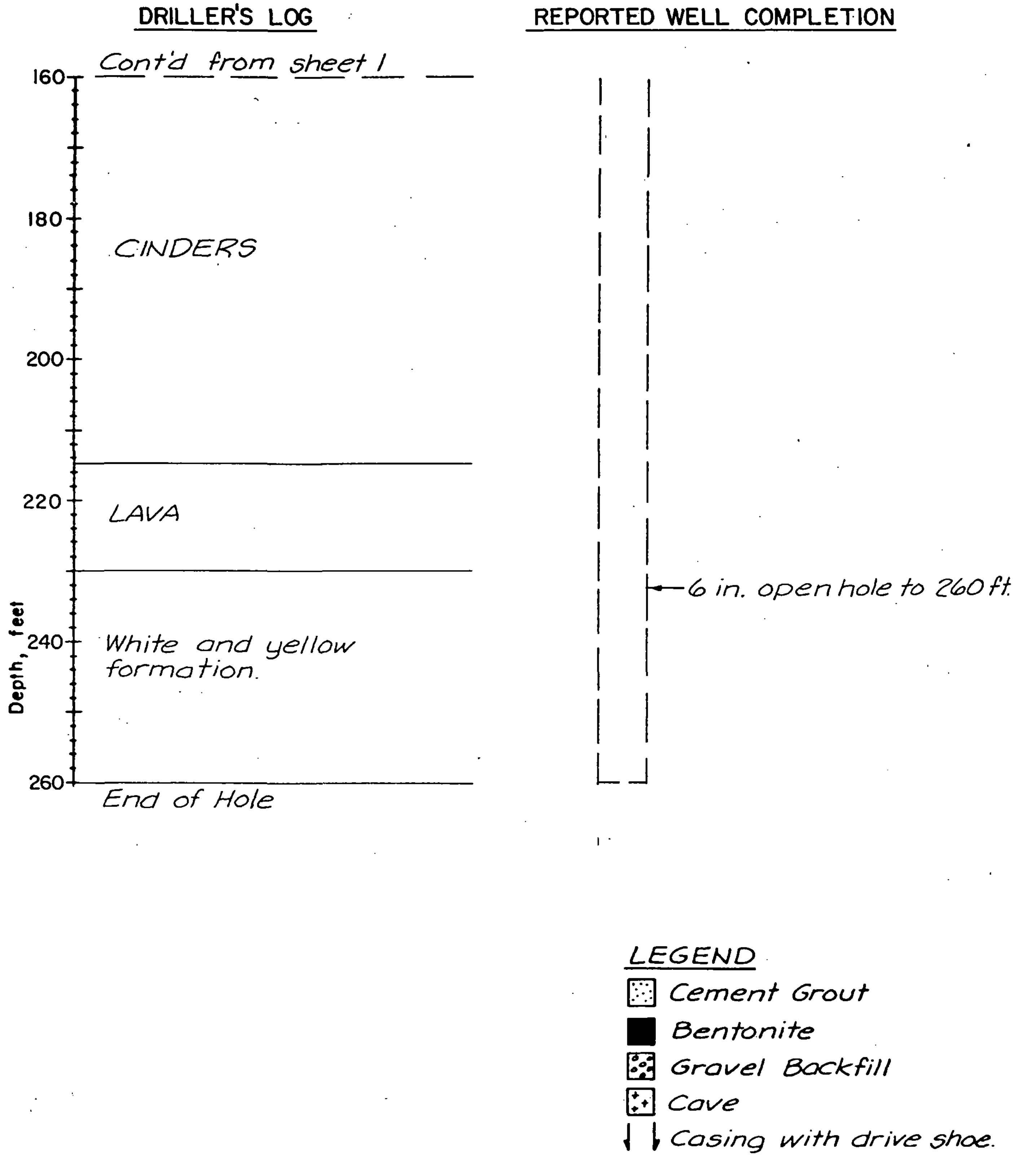


PROJECT NO. 842-1543 DRAWN REVIEWED DATE

Golder Associates

LITHOLOGY AND WELL COMPLETION MONSANTO TW 2

Figure



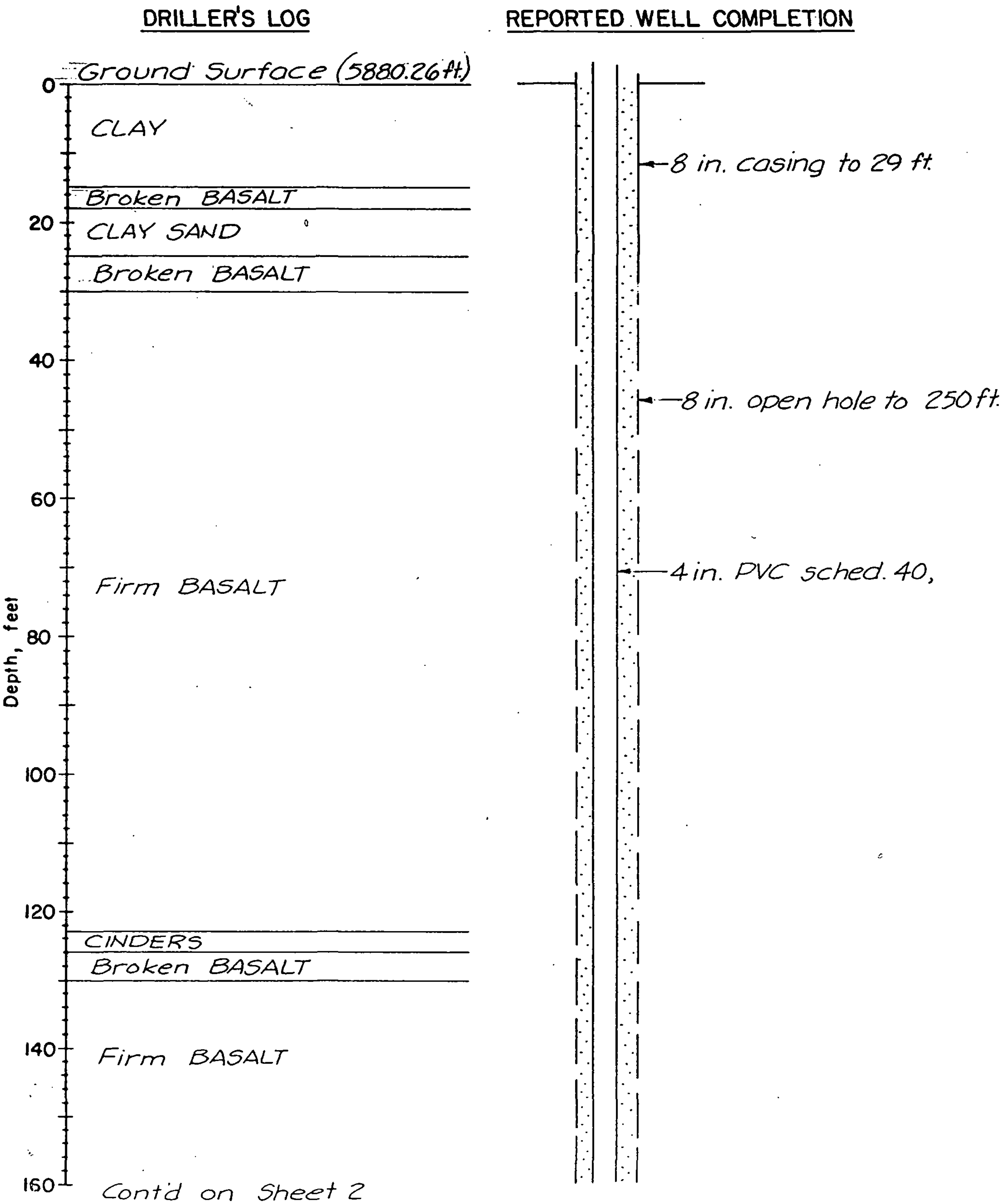
Scale 1 in. to 20 ft

Golder Associates

PROJECT NO. 842-1543 DRAWN ...... REVIEWED ...... DATE ......

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 3

Figure A-3



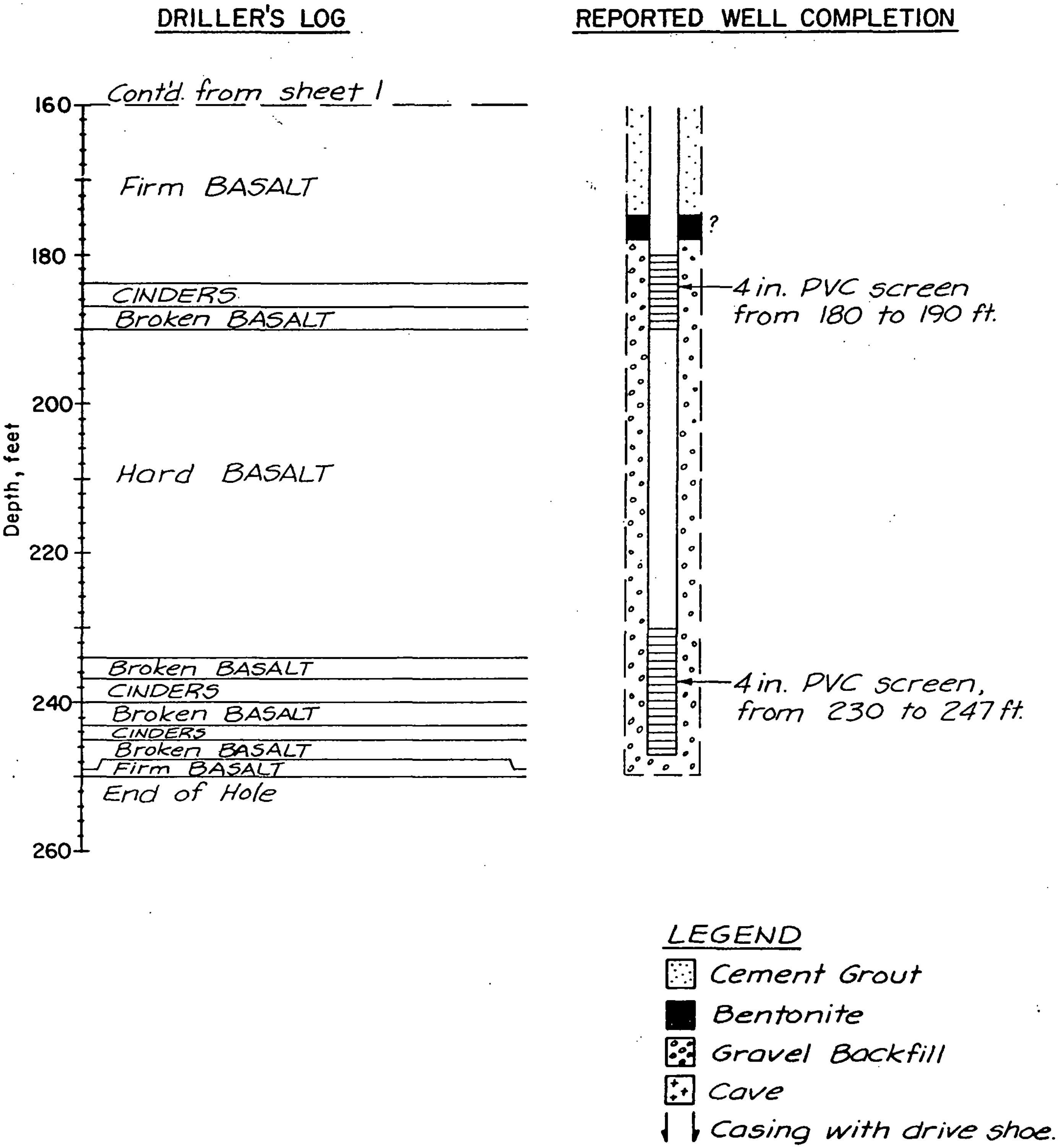
Scale 1 in. to 20 ft

Golder Associates

PROJECT NO. 842-1543 DRAWN REVIEWED DATE

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 3

Figure

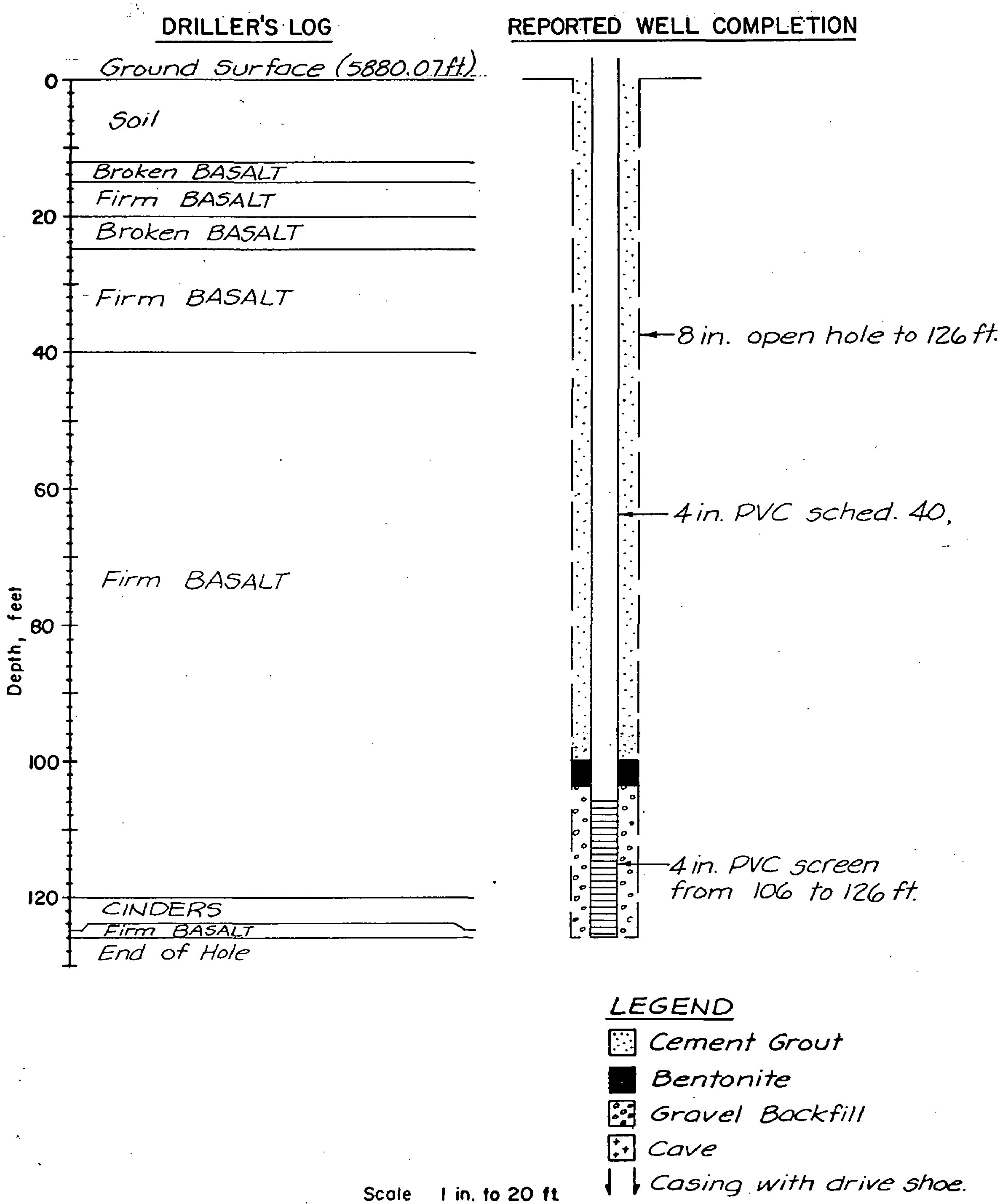


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 4

Figure A-4

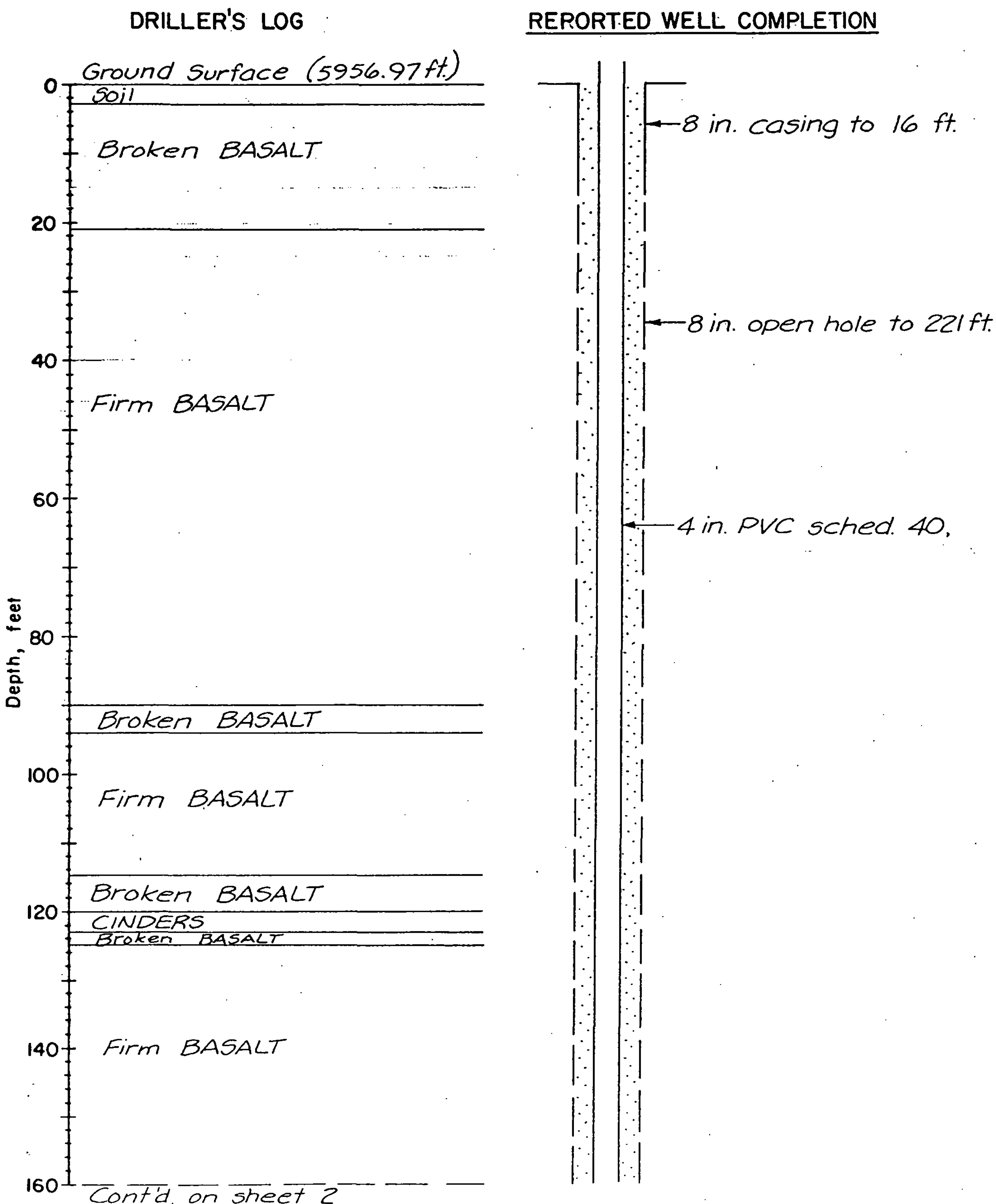


Golder Associates

PROJECT NO. 842-1543 DRAWN ...... REVIEWED ...... DATE ......

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 5

Figure A-5



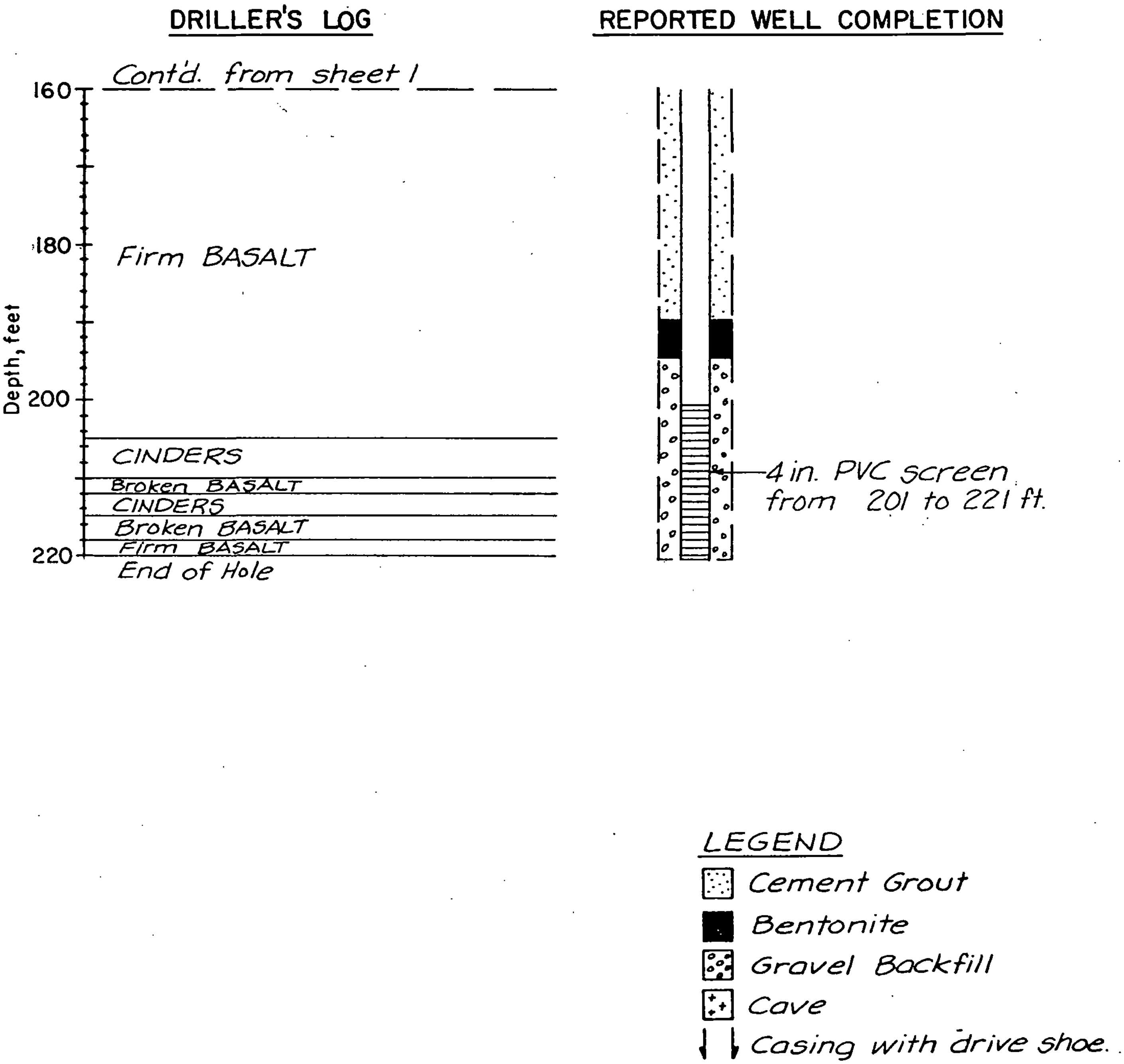
Scale 1 in. to 20 ft

PROJECT NO. 842-1543 DRAWN REVIEWED DATE

Golder Associates

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 5

Figure

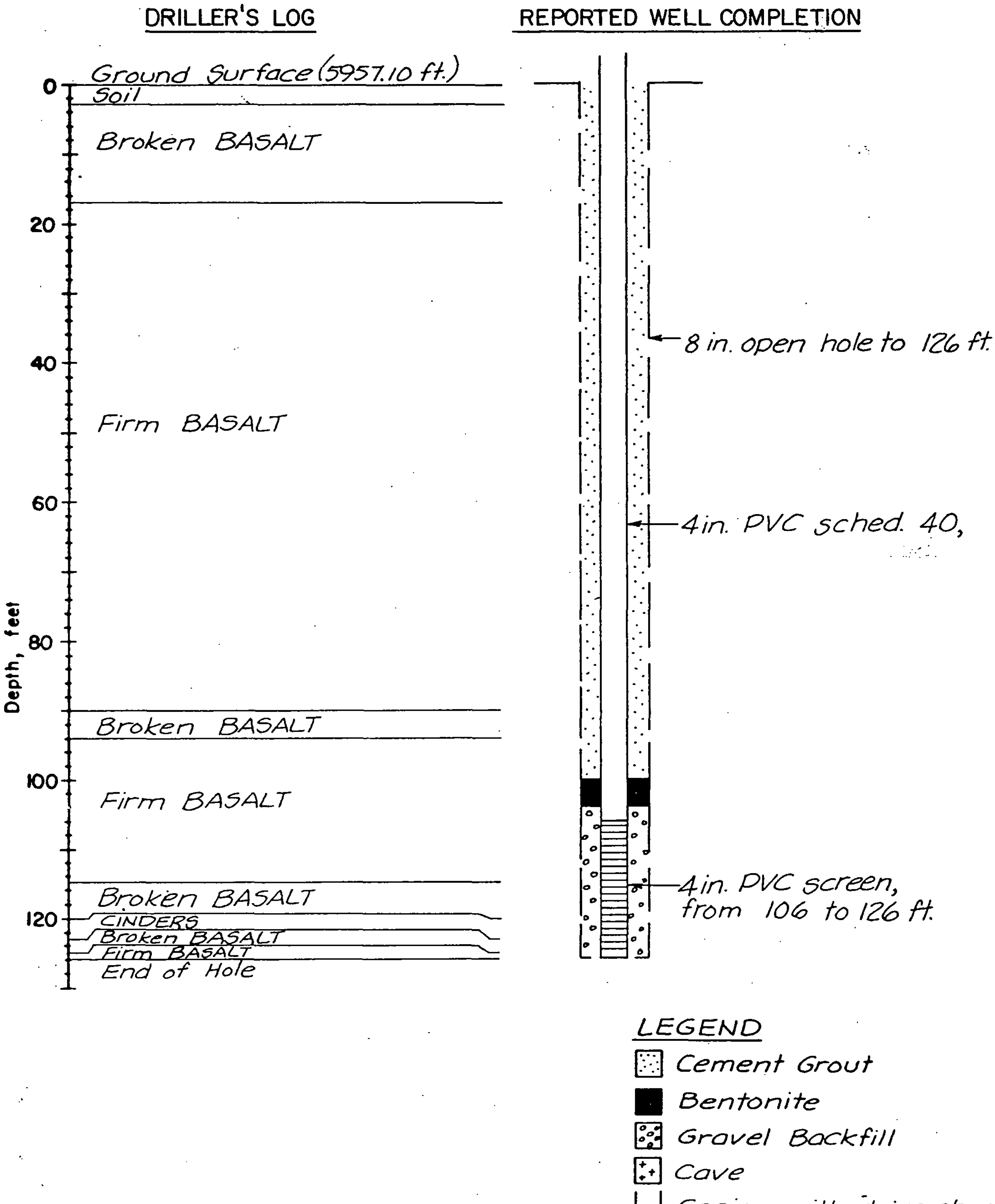


Scale 1 in. to 20 ft

Golder Associates

PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE ....

LITHOLOGY AND WELL COMPLETION MONSANTO TW 6	Figure A-6



Scale 1 in. to 20 ft

Golder Associates

PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE ....

Appendix C

Water Level Monitoring Data and Test Well Hydrographs

WATER-LEVEL DATA FOR TEST WELL: TW-2

MEASURING POINT (MP)
1 MP ELEVATION = 5989.97 (FT MSL) : TOP OF CASING

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-26-84	1415	207.594	1	4	49.95	49.95	5940.02
8- 4-84	1329	216.562	1	2	50.24	49.82	5940.15
8- 8-84	1600	220.667	1	1	50.06	49.96	5940.01
8- 8-84	1655	220.705	1	1	50.01	49.91	5940.06
8- 9-84	852	221.369	1	1	50.31	50.21	5939.76
8-10-84	800	222.333	1	1	50.20	50.10	5939.87
8-13-84	902	225.376	1	1	50.12	50.02	5939.95
8-13-84	1402	225.585	1	1	50.20	50.10	5939.87
8-13-84	1650	225.701	1	1	50.12	50.02	5939.95
8-13-84	1651	225.702	1	1	50.12	50.02	5939.95
8-13-84	1652	225.703	1	1	50.14	50.04	5939.93
8-13-84	1653	225.703	1	1	50.11	50.01	5939.96
8-13-84	1654	225.704	1	1	50.14	50.04	5939.93
8-13-84	1655	225.705	1	1	50.14	50.04	5939.93
8-13-84	1656	225.706	1	1	50.11	50.01	5939.96
8-13-84	1657	225.706	1	1	50.14	50.04	5939.93
8-13-84	1658	225.707	1	1	50.14	50.04	5939.93
8-13-84	1659	225.708	1	1	50.12	50.02	5939.95
8-13-84	1700	225.708	1	1	50.13	50.03	5939.94
8-13-84	1701	225.709	1	1	50.12	50.02	5939.95
8-13-84	1702	225.710	1	1	50.14	50.04	5939.93
8-13-84	1703	225.710	1	1	50.13	50.03	5939.94
8-13-84	1704	225.711	1	1	50.13	50.03	5939.94
8-13-84	1705	225.712	1	1	50.13	50.03	5939.94
8-13-84	1706	225.713	1	1	50.10	50.00	5939.97
8-13-84	1707	225.713	1	1	50.10	50.00	5939.97
8-13-84	1708	225.714	1	1	50.14	50.04	5939.93
8-13-84	1709	225.715	1	1	50.13	50.03	5939.94
8-13-84	1710	225.715	1	1	50.10	50.00	5939.97
8-13-84	1711	225.716	1	1	50.14	50.04	5939.93
8-13-84	1712	225.717	1	1	50.11	50.01	5939.96
8-13-84	1713	225.717	1	1	50.11	50.01	5939.96
8-13-84	1714	225.718	1	1	50.11	50.01	5939.96
8-13-84	1715	225.719	1	1	50.11	50.01	5939.96
8-13-84	1716	225.719	1	1	50.12	50.02	5939.95
8-13-84	1717	225.720	1	1	50.12	50.02	5939.95
8-13-84	1718	225.721	1	1	50.12	50.02	5939.95
8-13-84	1719	225.722	1	1	50.12	50.02	5939.95
8-13-84	1720	225.722	1	1	50.12	50.02	5939.95
8-14-84	823	226.349	1	1	50.20	50.10	5939.87
8-14-84	1604	226.669	1	1	50.10	50.00	5939.97
8-15-84	816	227.344	1	1	50.18	50.08	5939.89

TW-2 (CONT.)

8-16-84	807	228.338	1	1	50.19	50.09	5939.88
8-17-84	805	229.337	1	1	50.22	50.12	5939.85
8-20-84	1008	232.422	1	1	50.22	50.12	5939.85
8-21-84	851	233.369	1	1	50.27	50.17	5939.80
8-23-84	722	235.307	1	2	50.68	50.26	5939.71
8-27-84	1653	239.703	1	3	50.24	50.24	5939.73
8-28-84	1402	240.585	1	1	50.42	50.32	5939.65
9- 5-84	1648	248.700	1	3	50.42	50.42	5939.55
9-10-84	724	253.308	1	3	50.47	50.47	5939.50
9-12-84	1539	255.652	1	3	50.52	50.52	5939.45
9-14-84	1048	257.450	1	3	50.57	50.57	5939.40
10-18-84	1435	291.608	1	3	51.15	51.15	5938.82
10-25-84	1050	298.451	1	3	51.26	51.26	5938.71
10-27-84	1350	300.576	1	3	51.25	51.25	5938.72
10-29-84	830	302.354	1	3	51.28	51.28	5938.69
11- 1-84	905	305.378	1	3	51.36	51.36	5938.61
11- 3-84	1335	307.566	1	3	51.38	51.38	5938.59
11- 6-84	1420	310.597	1	3	51.29	51.29	5938.68
11-21-84	737	325.317	1	3	51.57	51.57	5938.40
11-26-84	1558	330.665	1	3	51.57	51.57	5938.40
11-28-84	1035	332.441	1	3	51.57	51.57	5938.40
11-30-84	1041	334.445	1	3	51.62	51.62	5938.35
12- 3-84	1301	337.542	1	3	51.64	51.64	5938.33
12- 5-84	1546	339.657	1	3	51.70	51.70	5938.27
12- 8-84	1345	342.573	1	3	51.67	51.67	5938.30
12-10-84	934	344.399	1	3	51.77	51.77	5938.20
12-12-84	1115	346.469	1	3	51.69	51.69	5938.28
1-31-85	925	212.392	1	3	52.46	52.46	5937.51
2- 2-85	1245	183.531	1	3	52.46	52.46	5937.51
2- 4-85	1015	185.427	1	3	52.53	52.53	5937.44
2- 7-85	830	188.354	1	3	52.49	52.49	5937.48
2-11-85	900	192.375	1	3	52.82	52.82	5937.15
2-15-85	912	196.383	1	3	52.75	52.75	5937.22

WATER-LEVEL DATA FOR TEST WELL: TW-3

MEASURING POINT (MP)
1 MP ELEVATION = 5881.81 (FT MSL) : HOLE IN CAP AT TOP OF CASIN
2 MP ELEVATION = 5881.76 (FT MSL) : MP 1.46 FT. ABOVE CEMENT

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-26-84	1502	207.626	1	4	1.86	1.86	5879.95
7-27-84	1210	208.507	1	1	2.06	2.06	5879.75
7-28-84	905	209.378	1	1	2.03	2.03	5879.78
7-30-84	1048	211.450	1	1	1.85	1.85	5879.96
7-31-84	1214	212.510	1	1	1.63	1.63	5880.18
8- 1-84	1258	213.540	1	1	1.44	1.44	5880.37
8- 2-84	1059	214.458	1	1	1.34	1.34	5880.47
8- 2-84	1339	214.569	1	1	1.30	1.30	5880.51
8- 2-84	1343	214.572	1	1	1.56	1.56	5880.25
8- 2-84	1344	214.572	1	1	1.61	1.61	5880.20
8- 2-84	1345	214.573	1	1	1.67	1.67	5880.14
8- 2-84	1346	214.574	1	1	1.67	1.67	5880.14
8- 2-84	1348	214.575	1	1	1.70	1.70	5880.11
8- 2-84	1350	214.576	1	1	1.71	1.71	5880.10
8- 2-84	1352	214.578	1	1	1.74	1.74	5880.07
8- 2-84	1354	214.579	1	1	1.77	1.77	5880.04
8- 2-84	1356	214.581	1	1	1.77	1.77	5880.04
8- 2-84	1358	214.582	1	1	1.86	1.86	5879.95
8- 2-84	1400	214.583	1	1	1.85	1.85	5879.96
8- 2-84	1405	214.587	1	1	1.85	1.85	5879.96
8- 2-84	1410	214.590	1	1	1.87	1.87	5879.94
8- 2-84	1415	214.594	1	1	1.89	1.89	5879.92
8- 2-84	1420	214.597	1	1	1.91	1.91	5879.90
8- 2-84	1425	214.601	1	1	1.93	1.93	5879.88
8- 2-84	1430	214.604	1	1	1.95	1.95	5879.86
8- 2-84	1435	214.608	1	1	1.94	1.94	5879.87
8- 2-84	1440	214.611	1	1	1.96	1.96	5879.85
8- 2-84	1445	214.615	1	1	1.98	1.98	5879.83
8- 2-84	1446	214.615	1	1	1.91	1.91	5879.90
8- 2-84	1447	214.616	1	1	1.66	1.66	5880.15
8- 2-84	1448	214.617	1	1	1.64	1.64	5880.17
8- 2-84	1449	214.617	1	1	1.63	1.63	5880.18
8- 2-84	1451	214.619	1	1	1.59	1.59	5880.22
8- 2-84	1453	214.620	1	1	1.55	1.55	5880.26
8- 2-84	1455	214.622	1	1	1.53	1.53	5880.28
8- 2-84	1500	214.625	1	1	1.52	1.52	5880.29
8- 2-84	1505	214.628	1	1	1.48	1.48	5880.33
8- 2-84	1510	214.632	1	1	1.44	1.44	5880.37
8- 2-84	1515	214.635	1	1	1.44	1.44	5880.37
8- 2-84	1520	214.639	1	1	1.44	1.44	5880.37
8- 2-84	1525	214.642	1	1	1.43	1.43	5880.38

TW-3 (CONT.)

8- 2-84	1530	214.646	1	1	1.40	1.40	5880.41
8- 2-84	1535	214.649	1	1	1.40	1.40	5880.41
8- 2-84	1540	214.653	1	1	1.39	1.39	5880.42
8- 2-84	1544	214.656	1	1	1.40	1.40	5880.41
8- 3-84	958	215.415	1	1	1.20	1.20	5880.61
8- 4-84	852	216.369	1	1	1.13	1.13	5880.68
8- 6-84	1852	218.786	1	1	1.24	1.24	5880.57
8- 7-84	1750	219.743	1	1	1.42	1.42	5880.39
8- 8-84	1814	220.760	1	1	1.54	1.54	5880.27
8- 9-84	1538	221.651	1	1	1.72	1.72	5880.09
8-10-84	938	222.401	1	1	1.75	1.75	5880.06
8-13-84	1153	225.495	1	1	1.96	1.96	5879.85
8-14-84	934	226.399	1	1	1.96	1.96	5879.85
8-15-84	931	227.397	1	1	2.00	2.00	5879.81
8-16-84	922	228.390	1	1	2.04	2.04	5879.77
8-17-84	919	229.388	1	1	2.13	2.13	5879.68
8-17-84	1030	229.438	1	1	2.13	2.13	5879.68
8-20-84	850	232.368	1	1	2.15	2.15	5879.66
8-22-84	713	234.301	1	1	2.29	2.29	5879.52
8-23-84	1308	235.547	1	1	2.29	2.29	5879.52
8-27-84	908	239.381	1	3	2.31	2.31	5879.50
8-29-84	1515	241.635	1	3	2.34	2.34	5879.47
8-31-84	914	243.385	1	2	2.30	2.30	5879.51
9- 4-84	920	247.389	1	3	2.39	2.39	5879.42
9- 6-84	814	249.343	2	2	2.33	2.33	5879.43
9- 7-84	1429	250.603	2	3	2.36	2.36	5879.40
9-10-84	830	253.354	2	3	2.36	2.36	5879.40
9-11-84	921	254.390	2	3	2.34	2.34	5879.42
9-12-84	1510	255.632	2	3	2.39	2.39	5879.37
9-13-84	1443	256.613	2	3	2.41	2.41	5879.35
9-14-84	1023	257.433	2	3	2.41	2.41	5879.35
9-19-84	821	262.348	2	3	2.47	2.47	5879.29
9-20-84	1539	263.652	2	3	2.35	2.35	5879.41
9-21-84	912	264.383	2	3	2.42	2.42	5879.34
9-24-84	1342	267.571	2	3	2.42	2.42	5879.34
9-24-84	1353	267.578	2	3	2.42	2.42	5879.34
10- 1-84	1107	274.463	2	3	2.39	2.39	5879.37
10- 4-84	1352	277.578	2	3	2.39	2.39	5879.37
10- 8-84	954	281.413	2	3	2.51	2.51	5879.25
10-15-84	1020	288.431	2	3	1.87	1.87	5879.89
10-17-84	1530	290.646	2	3	1.90	1.90	5879.86
10-18-84	1455	291.622	2	3	1.95	1.95	5879.81
10-22-84	1530	295.646	2	3	1.97	1.97	5879.79
10-25-84	1025	298.434	2	3	2.02	2.02	5879.74
10-27-84	1415	300.594	2	3	1.97	1.97	5879.79
10-29-84	900	302.375	2	3	1.98	1.98	5879.78
11- 1-84	1030	305.438	2	3	2.03	2.03	5879.73
11- 3-84	1300	307.542	2	3	2.00	2.00	5879.76
11- 6-84	1605	310.670	2	3	2.07	2.07	5879.69
11-10-84	1015	314.427	2	3	2.10	2.10	5879.66
11-16-84	1405	320.587	2	3	2.16	2.16	5879.60
11-19-84	823	323.349	2	3	2.28	2.28	5879.48
11-21-84	852	325.369	2	3	2.28	2.28	5879.48
11-26-84	1638	330.693	2	3	2.36	2.36	5879.40
11-28-84	925	332.392	2	3	2.32	2.32	5879.44
11-30-84	1028	334.436	2	3	2.34	2.34	5879.42
12- 3-84	1430	337.604	2	3	2.39	2.39	5879.37

TW-3 (CONT.)

12- 8-84	1640	342.694	2	3	2.48	2.48	5879.28
12-10-84	1005	344.420	2	3	2.46	2.46	5879.30
12-12-84	930	346.396	2	3	2.43	2.43	5879.33
1-28-85	1610	209.674	2	3	2.95	2.95	5878.81
1-31-85	1130	212.479	2	3	3.12	3.12	5878.64
2- 2-85	850	183.368	2	3	3.12	3.12	5878.64
2- 4-85	1315	185.552	2	3	3.15	3.15	5878.61
2- 6-85	1050	187.451	2	3	3.15	3.15	5878.61
2-11-85	1040	192.444	2	3	3.12	3.12	5878.64
2-13-85	1115	194.469	2	3	3.20	3.20	5878.56
2-15-85	1055	196.455	2	3	3.15	3.15	5878.61

WATER-LEVEL DATA FOR TEST WELL: TW-4

MEASURING POINT (MP)
1 MP ELEVATION = 5881.94 (FT MSL) : HOLE IN CAP AT TOP OF CASIN
2 MP ELEVATION = 5881.89 (FT MSL) : MP 1.82 FT. ABOVE CEMENT

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-26-84	1506	207.629	1	4	1.98	1.98	5879.96
7-27-84	1212	208.508	1	1	2.14	2.14	5879.80
7-28-84	902	209.376	1	1	2.11	2.11	5879.83
7-30-84	1047	211.449	1	1	1.92	1.92	5880.02
7-31-84	1742	212.738	1	1	1.65	1.65	5880.29
8- 1-84	1908	213.797	1	1	1.45	1.45	5880.49
8- 2-84	1115	214.469	1	1	1.41	1.41	5880.53
8- 2-84	1548	214.658	1	1	1.48	1.48	5880.46
8- 2-84	1555	214.663	1	1	1.49	1.49	5880.45
8- 2-84	1557	214.665	1	1	21.17	21.10	5860.84
8- 2-84	1558	214.665	1	1	40.21	40.11	5841.83
8- 2-84	1559	214.666	1	1	50.20	50.10	5831.84
8- 2-84	1600	214.667	1	1	61.45	61.30	5820.64
8- 2-84	1601	214.667	1	1	77.91	77.73	5804.21
8- 2-84	1602	214.668	1	1	88.19	87.98	5793.96
8- 2-84	1603	214.669	1	1	97.51	97.25	5784.69
8- 2-84	1604	214.669	1	1	104.77	104.50	5777.44
8- 2-84	1606	214.671	1	1	100.40	100.13	5781.81
8- 2-84	1607	214.672	1	1	91.70	91.47	5790.47
8- 2-84	1608	214.672	1	1	85.58	85.38	5796.56
8- 2-84	1609	214.673	1	1	79.64	79.46	5802.48
8- 2-84	1610	214.674	1	1	75.01	74.84	5807.10
8- 2-84	1611	214.674	1	1	69.67	69.50	5812.44
8- 2-84	1612	214.675	1	1	65.19	65.03	5816.91
8- 2-84	1613	214.676	1	1	60.48	60.33	5821.61
8- 2-84	1614	214.676	1	1	56.31	56.18	5825.76
8- 2-84	1615	214.677	1	1	52.28	52.17	5829.77
8- 2-84	1616	214.678	1	1	48.50	48.40	5833.54
8- 2-84	1618	214.679	1	1	41.65	41.55	5840.39
8- 2-84	1619	214.680	1	1	38.57	38.47	5843.47
8- 2-84	1620	214.681	1	1	35.80	35.70	5846.24
8- 2-84	1621	214.681	1	1	32.85	32.75	5849.19
8- 2-84	1622	214.682	1	1	30.41	30.31	5851.63
8- 2-84	1623	214.683	1	1	28.20	28.11	5853.83
8- 2-84	1624	214.683	1	1	26.05	25.96	5855.98
8- 2-84	1625	214.684	1	1	24.02	23.94	5858.00
8- 2-84	1626	214.685	1	1	22.12	22.04	5859.90
8- 2-84	1627	214.685	1	1	20.45	20.38	5861.56
8- 2-84	1628	214.686	1	1	18.84	18.78	5863.16
8- 2-84	1629	214.687	1	1	17.36	17.31	5864.63
8- 2-84	1630	214.688	1	1	15.99	15.95	5865.99

TW-4 (CONT.)

8- 2-84	1631	214.688	1	1	14.69	14.66	5867.28
8- 2-84	1633	214.690	1	1	12.44	12.42	5869.52
8- 2-84	1634	214.690	1	1	11.44	11.43	5870.51
8- 2-84	1635	214.691	1	1	10.55	10.55	5871.39
8- 2-84	1636	214.692	1	1	9.74	9.74	5872.20
8- 2-84	1638	214.693	1	1	8.24	8.24	5873.70
8- 2-84	1640	214.694	1	1	7.09	7.09	5874.85
8- 2-84	1641	214.695	1	1	6.50	6.50	5875.44
8- 2-84	1642	214.696	1	1	6.06	6.06	5875.88
8- 2-84	1643	214.697	1	1	5.62	5.62	5876.32
8- 2-84	1644	214.697	1	1	5.08	5.08	5876.86
8- 2-84	1645	214.698	1	1	4.84	4.84	5877.10
8- 3-84	955	215.413	1	1	1.30	1.30	5880.64
8- 4-84	854	216.371	1	1	1.22	1.22	5880.72
8- 6-84	1751	218.744	1	1	1.33	1.33	5880.61
8- 7-84	1755	219.747	1	1	1.50	1.50	5880.44
8- 8-84	1821	220.765	1	1	1.61	1.61	5880.33
8- 9-84	1553	221.662	1	1	1.75	1.75	5880.19
8-10-84	944	222.406	1	1	1.89	1.89	5880.05
8-13-84	1205	225.503	1	1	2.12	2.12	5879.82
8-14-84	928	226.394	1	1	2.11	2.11	5879.83
8-15-84	936	227.400	1	1	2.12	2.12	5879.82
8-16-84	916	228.386	1	1	2.15	2.15	5879.79
8-17-84	926	229.393	1	1	2.21	2.21	5879.73
8-20-84	1125	232.476	1	1	2.44	2.44	5879.50
8-22-84	712	234.300	1	1	2.32	2.32	5879.62
8-23-84	1303	235.544	1	1	2.34	2.34	5879.60
8-24-84	846	236.365	1	3	2.36	2.36	5879.58
8-29-84	1513	241.634	1	3	2.43	2.43	5879.51
8-31-84	905	243.378	1	2	2.42	2.42	5879.52
9- 4-84	921	247.390	1	3	2.49	2.49	5879.45
9- 6-84	817	249.345	2	2	2.41	2.41	5879.48
9- 7-84	1431	250.605	2	3	2.48	2.48	5879.41
9-10-84	832	253.356	2	3	2.48	2.48	5879.41
9-11-84	922	254.390	2	3	2.46	2.46	5879.43
9-12-84	1511	255.633	2	3	2.51	2.51	5879.38
9-13-84	1444	256.614	2	3	2.51	2.51	5879.38
9-14-84	1024	257.433	2	3	2.51	2.51	5879.38
9-19-84	822	262.349	2	3	2.58	2.58	5879.31
9-20-84	1540	263.653	2	3	2.44	2.44	5879.45
9-21-84	913	264.384	2	3	2.51	2.51	5879.38
9-24-84	1342	267.571	2	3	2.53	2.53	5879.36
9-24-84	1353	267.578	2	3	2.53	2.53	5879.36
10- 1-84	1107	274.463	2	3	2.49	2.49	5879.40
10- 4-84	1352	277.578	2	3	2.48	2.48	5879.41
10- 8-84	955	281.413	2	3	2.61	2.61	5879.28
10-15-84	1020	288.431	2	3	1.96	1.96	5879.93
10-17-84	1525	290.642	2	3	2.00	2.00	5879.89
10-18-84	1456	291.622	2	3	2.05	2.05	5879.84
10-22-84	1530	295.646	2	3	2.07	2.07	5879.82
10-25-84	1025	298.434	2	3	2.10	2.10	5879.79
10-27-84	1415	300.594	2	3	2.07	2.07	5879.82
10-29-84	900	302.375	2	3	2.07	2.07	5879.82
11- 1-84	1030	305.438	2	3	2.13	2.13	5879.76
11- 3-84	1300	307.542	2	3	2.12	2.12	5879.77
11- 6-84	1605	310.670	2	3	2.12	2.12	5879.77
11-10-84	1035	314.441	2	3	2.20	2.20	5879.69

TW-4 (CONT.)

11-16-84	1405	320.587	2	3	2.25	2.25	5879.64
11-19-84	833	323.356	2	3	2.36	2.36	5879.53
11-21-84	852	325.369	2	3	2.36	2.36	5879.53
11-26-84	1638	330.693	2	3	2.43	2.43	5879.46
11-28-84	925	332.392	2	3	2.39	2.39	5879.50
11-30-84	1008	334.422	2	3	2.43	2.43	5879.46
12- 3-84	1430	337.604	2	3	2.48	2.48	5879.41
12- 8-84	1640	342.694	2	3	2.54	2.54	5879.35
12-10-84	1005	344.420	2	3	2.53	2.53	5879.36
12-12-84	930	346.396	2	3	2.53	2.53	5879.36
1-28-85	1610	209.674	2	3	3.02	3.02	5878.87
1-31-85	1130	212.479	2	3	3.18	3.18	5878.71
2- 2-85	850	183.368	2	3	3.18	3.18	5878.71
2- 4-85	1315	185.552	2	3	3.22	3.22	5878.67
2- 6-85	1050	187.451	2	3	3.18	3.18	5878.71
2-11-85	1040	192.444	2	3	3.12	3.12	5878.77
2-13-85	1115	194.469	2	3	3.25	3.25	5878.64
2-15-85	1055	196.455	2	3	3.25	3.25	5878.64

WATER-LEVEL DATA FOR TEST WELL: TW-5

MEASURING POINT (MP)
1 MP ELEVATION = 5958.72 (FT MSL) : HOLE IN CAP AT TOP OF CASIN
2 MP ELEVATION = 5958.67 (FT MSL) : MP 1.71 FT. ABOVE CEMENT

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-27-84	853	208.370	1	4	69.63	69.63	5889.09
7-30-84	1337	211.567	1	1	69.38	69.21	5889.51
7-31-84	952	212.411	1	1	69.21	69.04	5889.68
7-31-84	1001	212.417	1	1	69.21	69.04	5889.68
8- 1-84	1032	213.439	1	1	69.05	68.88	5889.84
8- 1-84	1458	213.624	1	1	69.04	68.87	5889.85
8- 1-84	1502	213.626	1	1	81.15	80.97	5877.75
8- 1-84	1503	213.627	1	1	88.55	88.34	5870.38
8- 1-84	1504	213.628	1	1	93.50	93.26	5865.46
8- 1-84	1505	213.628	1	1	96.82	96.57	5862.15
8- 1-84	1506	213.629	1	1	99.44	99.17	5859.55
8- 1-84	1507	213.630	1	1	101.33	101.06	5857.66
8- 1-84	1508	213.631	1	1	103.06	102.79	5855.93
8- 1-84	1509	213.631	1	1	104.35	104.08	5854.64
8- 1-84	1510	213.632	1	1	105.55	105.28	5853.44
8- 1-84	1511	213.633	1	1	106.50	106.23	5852.49
8- 1-84	1512	213.633	1	1	107.19	106.92	5851.80
8- 1-84	1514	213.635	1	1	108.26	107.99	5850.73
8- 1-84	1516	213.636	1	1	109.03	108.76	5849.96
8- 1-84	1518	213.638	1	1	109.51	109.24	5849.48
8- 1-84	1520	213.639	1	1	109.82	109.55	5849.17
8- 1-84	1522	213.640	1	1	109.91	109.64	5849.08
8- 1-84	1524	213.642	1	1	110.04	109.77	5848.95
8- 1-84	1526	213.643	1	1	110.06	109.79	5848.93
8- 1-84	1528	213.644	1	1	110.10	109.83	5848.89
8- 1-84	1530	213.646	1	1	110.17	109.90	5848.82
8- 1-84	1535	213.649	1	1	104.21	103.94	5854.78
8- 1-84	1538	213.651	1	1	108.25	107.98	5850.74
8- 1-84	1540	213.653	1	1	110.49	110.22	5848.50
8- 1-84	1545	213.656	1	1	112.16	111.89	5846.83
8- 1-84	1550	213.660	1	1	111.97	111.70	5847.02
8- 1-84	1555	213.663	1	1	111.88	111.61	5847.11
8- 1-84	1600	213.667	1	1	111.98	111.71	5847.01
8- 1-84	1605	213.670	1	1	111.43	111.16	5847.56
8- 1-84	1610	213.674	1	1	112.49	112.22	5846.50
8- 1-84	1612	213.675	1	1	90.77	90.55	5868.17
8- 1-84	1613	213.676	1	1	81.23	81.05	5877.67
8- 1-84	1614	213.676	1	1	74.97	74.80	5883.92
8- 1-84	1615	213.677	1	1	71.27	71.10	5887.62
8- 1-84	1616	213.678	1	1	69.86	69.69	5889.03
8- 1-84	1617	213.678	1	1	69.45	69.28	5889.44

TW-5 (CONT.)

8- 1-84	1618	213.679	1	1	69.31	69.14	5889.58
8- 1-84	1620	213.681	1	1	69.20	69.03	5889.69
8- 1-84	1622	213.682	1	1	69.19	69.02	5889.70
8- 1-84	1624	213.683	1	1	69.15	68.98	5889.74
8- 1-84	1626	213.685	1	1	69.10	68.93	5889.79
8- 1-84	1628	213.686	1	1	69.12	68.95	5889.77
8- 1-84	1631	213.688	1	1	69.09	68.92	5889.80
8- 1-84	1635	213.691	1	1	69.08	68.91	5889.81
8- 1-84	1640	213.694	1	1	69.08	68.91	5889.81
8- 1-84	1645	213.698	1	1	69.09	68.92	5889.80
8- 1-84	1650	213.701	1	1	69.08	68.91	5889.81
8- 1-84	1655	213.705	1	1	69.09	68.92	5889.80
8- 1-84	1857	213.790	1	1	69.01	68.84	5889.88
8- 2-84	921	214.390	1	1	68.95	68.78	5889.94
8- 3-84	1220	215.514	1	1	68.70	68.53	5890.19
8- 6-84	1335	218.566	1	1	68.80	68.63	5890.09
8- 6-84	1841	218.778	1	1	68.87	68.70	5890.02
8- 7-84	1509	219.631	1	1	68.99	68.82	5889.90
8- 8-84	1736	220.733	1	1	69.24	69.07	5889.65
8- 9-84	1518	221.638	1	1	69.40	69.23	5889.49
8-10-84	1002	222.418	1	1	69.42	69.25	5889.47
8-13-84	1103	225.460	1	1	69.62	69.45	5889.27
8-14-84	851	226.369	1	1	69.64	69.47	5889.25
8-15-84	853	227.370	1	1	69.67	69.50	5889.22
8-16-84	847	228.366	1	1	69.72	69.55	5889.17
8-17-84	855	229.372	1	1	69.75	69.58	5889.14
8-20-84	918	232.388	1	1	69.81	69.64	5889.08
8-21-84	823	233.349	2	1	69.79	69.62	5889.05
8-22-84	731	234.313	2	1	69.80	69.63	5889.04
8-23-84	813	235.342	2	2	70.35	69.81	5888.86
8-24-84	1113	236.467	2	3	69.70	69.70	5888.97
8-27-84	1015	239.427	2	3	69.75	69.75	5888.92
8-29-84	1501	241.626	2	3	69.78	69.78	5888.89
8-31-84	821	243.348	2	2	70.33	69.79	5888.88
9- 4-84	943	247.405	2	3	69.83	69.83	5888.84
9- 6-84	757	249.331	2	2	70.39	69.85	5888.82
9- 7-84	1510	250.632	2	3	69.86	69.86	5888.81
9-10-84	744	253.322	2	3	69.84	69.84	5888.83
9-11-84	912	254.383	2	3	69.85	69.85	5888.82
9-12-84	1455	255.622	2	3	69.88	69.88	5888.79
9-14-84	920	257.389	2	3	69.91	69.91	5888.76
9-18-84	1430	261.604	2	3	70.04	70.04	5888.63
9-19-84	919	262.388	2	3	70.00	70.00	5888.67
9-25-84	845	268.365	2	3	69.95	69.95	5888.72
10- 9-84	915	282.385	2	3	70.01	70.01	5888.66
10-15-84	1125	288.476	2	3	70.11	70.11	5888.56
10-17-84	1520	290.639	2	3	70.09	70.09	5888.58
10-22-84	950	295.410	2	3	70.22	70.22	5888.45
10-25-84	1020	298.431	2	3	70.27	70.27	5888.40
10-27-84	1410	300.590	2	3	70.21	70.21	5888.46
10-29-84	850	302.368	2	3	70.24	70.24	5888.43
11- 1-84	940	305.403	2	3	70.27	70.27	5888.40
11- 3-84	1315	307.552	2	3	70.27	70.27	5888.40
11- 6-84	1445	310.615	2	3	70.27	70.27	5888.40
11- 9-84	840	313.361	2	3	70.34	70.34	5888.33
11-16-84	858	320.374	2	3	70.36	70.36	5888.31
11-19-84	936	323.400	2	3	70.42	70.42	5888.25

TW-5 (CONT.)

11-21-84	837	325.359	2	3	70.44	70.44	5888.23
11-26-84	1624	330.683	2	3	70.50	70.50	5888.17
11-28-84	1121	332.473	2	3	70.50	70.50	5888.17
11-30-84	940	334.403	2	3	70.54	70.54	5888.13
12- 3-84	1408	337.589	2	3	70.62	70.62	5888.05
12- 8-84	1540	342.653	2	3	70.72	70.72	5887.95
12-10-84	957	344.415	2	3	70.72	70.72	5887.95
12-12-84	1125	346.476	2	3	70.70	70.70	5887.97
1-29-85	1305	210.545	2	3	71.29	71.29	5887.38
1-31-85	935	212.399	2	3	71.32	71.32	5887.35
2- 2-85	1300	183.542	2	3	71.32	71.32	5887.35
2- 4-85	955	185.413	2	3	71.39	71.39	5887.28
2- 6-85	840	187.361	2	3	71.36	71.36	5887.31
2-11-85	905	192.378	2	3	71.46	71.46	5887.21
2-12-85	1210	193.507	2	3	71.47	71.47	5887.20
2-12-85	1435	193.608	2	3	71.49	71.49	5887.18
2-13-85	1000	194.417	2	3	71.52	71.52	5887.15
2-15-85	942	196.404	2	3	71.55	71.55	5887.12

WATER-LEVEL DATA FOR TEST WELL: TW-6

MEASURING POINT (MP)
1 MP ELEVATION = 5958.95 (FT MSL) : HOLE IN CAP AT TOP OF CASIN
2 MP ELEVATION = 5958.90 (FT MSL) : MP 1.85 FT. ABOVE CEMENT

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-26-84	1439	207.610	1	4	63.56	63.56	5895.39
7-27-84	851	208.369	1	4	64.72	64.72	5894.23
7-30-84	952	211.411	1	1	64.67	64.51	5894.44
7-30-84	1546	211.657	1	1	64.67	64.51	5894.44
7-31-84	1012	212.425	1	1	64.66	64.50	5894.45
8- 1-84	1010	213.424	1	1	64.54	64.38	5894.57
8- 1-84	1020	213.431	1	1	64.60	64.44	5894.51
8- 1-84	1158	213.499	1	2	65.02	64.50	5894.45
8- 1-84	1202	213.501	1	1	64.58	64.42	5894.53
8- 1-84	1713	213.717	1	1	64.57	64.41	5894.54
8- 1-84	1722	213.724	1	1	64.57	64.41	5894.54
8- 1-84	1728	213.728	1	1	64.91	64.75	5894.20
8- 1-84	1731	213.730	1	1	64.93	64.77	5894.18
8- 1-84	1735	213.733	1	1	64.93	64.77	5894.18
8- 1-84	1740	213.736	1	1	64.94	64.78	5894.17
8- 1-84	1750	213.743	1	1	64.95	64.79	5894.16
8- 1-84	1800	213.750	1	1	64.94	64.78	5894.17
8- 1-84	1817	213.762	1	1	64.96	64.80	5894.15
8- 1-84	1828	213.769	1	1	64.95	64.79	5894.16
8- 1-84	1831	213.772	1	1	64.62	64.46	5894.49
8- 1-84	1832	213.772	1	1	64.60	64.44	5894.51
8- 1-84	1834	213.774	1	1	64.59	64.43	5894.52
8- 1-84	1840	213.778	1	1	64.58	64.42	5894.53
8- 1-84	1850	213.785	1	1	64.58	64.42	5894.53
8- 2-84	944	214.406	1	1	64.54	64.38	5894.57
8- 3-84	1222	215.515	1	1	64.59	64.43	5894.52
8- 6-84	1131	218.480	1	1	64.49	64.33	5894.62
8- 6-84	1812	218.758	1	1	64.47	64.31	5894.64
8- 7-84	1500	219.625	1	1	64.54	64.38	5894.57
8- 8-84	1747	220.741	1	1	64.66	64.50	5894.45
8- 9-84	1506	221.629	1	1	64.72	64.56	5894.39
8-10-84	955	222.413	1	1	64.93	64.77	5894.18
8-13-84	1103	225.460	1	1	65.03	64.87	5894.08
8-14-84	859	226.374	1	1	65.07	64.91	5894.04
8-15-84	846	227.365	1	1	65.14	64.98	5893.97
8-16-84	847	228.366	1	1	65.20	65.04	5893.91
8-17-84	855	229.372	1	1	65.29	65.13	5893.82
8-20-84	914	232.385	1	1	65.24	65.08	5893.87
8-21-84	828	233.353	2	1	65.34	65.18	5893.72
8-22-84	727	234.310	2	1	65.37	65.21	5893.69
8-23-84	819	235.347	2	2	65.82	65.30	5893.60

TW-6 (CONT.)

8-24-84	1005	236.420	2	3	65.30	65.30	5893.60
8-29-84	1504	241.628	2	3	65.34	65.34	5893.56
8-31-84	1049	243.451	2	2	65.57	65.05	5893.85
9- 4-84	936	247.400	2	3	65.47	65.47	5893.43
9- 6-84	742	249.321	2	3	65.47	65.47	5893.43
9- 6-84	804	249.336	2	2	65.99	65.47	5893.43
9- 7-84	1206	250.504	2	3	65.48	65.48	5893.42
9-10-84	752	253.328	2	3	65.48	65.48	5893.42
9-11-84	901	254.376	2	3	65.45	65.45	5893.45
9-12-84	1500	255.625	2	3	65.53	65.53	5893.37
9-14-84	931	257.397	2	3	65.60	65.60	5893.30
9-18-84	1434	261.607	2	3	65.71	65.71	5893.19
9-19-84	917	262.387	2	3	65.75	65.75	5893.15
9-25-84	1015	268.427	2	3	65.71	65.71	5893.19
9-27-84	1420	270.597	2	3	65.68	65.68	5893.22
10- 9-84	915	282.385	2	3	65.81	65.81	5893.09
10-15-84	1125	288.476	2	3	65.86	65.86	5893.04
10-17-84	1520	290.639	2	3	65.81	65.81	5893.09
10-22-84	950	295.410	2	3	66.01	66.01	5892.89
10-25-84	1020	298.431	2	3	66.09	66.09	5892.81
10-27-84	1410	300.590	2	3	66.03	66.03	5892.87
10-29-84	850	302.368	2	3	66.09	66.09	5892.81
11- 1-84	940	305.403	2	3	66.14	66.14	5892.76
11- 3-84	1315	307.552	2	3	66.12	66.12	5892.78
11- 6-84	1445	310.615	2	3	66.14	66.14	5892.76
11- 9-84	845	313.365	2	3	66.17	66.17	5892.73
11-16-84	858	320.374	2	3	66.30	66.30	5892.60
11-19-84	936	323.400	2	3	66.39	66.39	5892.51
11-21-84	837	325.359	2	3	66.39	66.39	5892.51
11-26-84	1624	330.683	2	3	66.45	66.45	5892.45
11-28-84	1121	332.473	2	3	66.48	66.48	5892.42
11-30-84	940	334.403	2	3	66.57	66.57	5892.33
12- 3-84	1402	337.585	2	3	66.66	66.66	5892.24
12- 8-84	1540	342.653	2	3	66.80	66.80	5892.10
12-10-84	957	344.415	2	3	66.80	66.80	5892.10
12-12-84	1125	346.476	2	3	66.80	66.80	5892.10
1-29-85	1305	210.545	2	3	67.62	67.62	5891.28
1-31-85	935	212.399	2	3	67.65	67.65	5891.25
2- 2-85	1300	183.542	2	3	67.65	67.65	5891.25
2- 4-85	955	185.413	2	3	67.70	67.70	5891.20
2- 6-85	850	187.368	2	3	67.71	67.71	5891.19
2-11-85	910	192.382	2	3	67.81	67.81	5891.09
2-12-85	1350	193.576	2	3	67.91	67.91	5890.99
2-12-85	1435	193.608	2	3	67.88	67.88	5891.02
2-13-85	1000	194.417	2	3	67.90	67.90	5891.00
2-15-85	942	196.404	2	3	67.91	67.91	5890.99

WATER-LEVEL DATA FOR TEST WELL: TW-7

MEASURING POINT (MP)
1 MP ELEVATION = 5885.98 (FT MSL) : TOP OF 4 IN PVC CASING
2 MP ELEVATION = 5886.37 (FT MSL) : TOP OF 1.5 IN PVC PIPE

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE
5 STEVENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-26-84	1520	207.639	1	4	13.95	13.95	5872.03
7-27-84	1311	208.549	1	1	13.91	13.88	5872.10
7-28-84	1141	209.487	1	1	13.94	13.91	5872.07
7-30-84	1125	211.476	1	1	13.66	13.63	5872.35
7-30-84	1936	211.817	1	1	13.55	13.53	5872.45
7-31-84	1128	212.478	1	1	13.36	13.34	5872.64
8- 1-84	1226	213.518	1	1	13.10	13.08	5872.90
8- 2-84	1146	214.490	1	1	12.91	12.89	5873.09
8- 2-84	1716	214.719	1	1	12.81	12.79	5873.19
8- 2-84	1720	214.722	1	1	13.52	13.50	5872.48
8- 2-84	1721	214.723	1	1	13.61	13.58	5872.40
8- 2-84	1723	214.724	1	1	13.71	13.68	5872.30
8- 2-84	1725	214.726	1	1	13.71	13.68	5872.30
8- 2-84	1728	214.728	1	1	13.81	13.78	5872.20
8- 2-84	1729	214.728	1	1	13.84	13.81	5872.17
8- 2-84	1730	214.729	1	1	13.79	13.76	5872.22
8- 2-84	1732	214.731	1	1	13.91	13.88	5872.10
8- 2-84	1734	214.732	1	1	13.96	13.93	5872.05
8- 2-84	1736	214.733	1	1	13.92	13.89	5872.09
8- 2-84	1738	214.735	1	1	13.98	13.95	5872.03
8- 2-84	1740	214.736	1	1	14.00	13.97	5872.01
8- 2-84	1742	214.738	1	1	14.06	14.03	5871.95
8- 2-84	1744	214.739	1	1	14.03	14.00	5871.98
8- 2-84	1747	214.741	1	1	14.05	14.02	5871.96
8- 2-84	1750	214.743	1	1	14.07	14.04	5871.94
8- 2-84	1755	214.747	1	1	14.08	14.05	5871.93
8- 2-84	1800	214.750	1	1	14.09	14.06	5871.92
8- 2-84	1805	214.753	1	1	14.11	14.08	5871.90
8- 2-84	1810	214.757	1	1	14.12	14.09	5871.89
8- 2-84	1815	214.760	1	1	14.11	14.08	5871.90
8- 2-84	1826	214.768	1	1	14.14	14.11	5871.87
8- 2-84	1829	214.770	1	1	14.11	14.08	5871.90
8- 2-84	1831	214.772	1	1	13.50	13.48	5872.50
8- 2-84	1832	214.772	1	1	13.44	13.42	5872.56
8- 2-84	1833	214.773	1	1	13.40	13.38	5872.60
8- 2-84	1835	214.774	1	1	13.29	13.27	5872.71
8- 2-84	1837	214.776	1	1	13.26	13.24	5872.74
8- 2-84	1840	214.778	1	1	13.13	13.11	5872.87
8- 2-84	1843	214.780	1	1	13.18	13.16	5872.82
8- 2-84	1845	214.781	1	1	13.19	13.17	5872.81

8- 2-84	1846	214.782	1	1	13.19	13.17	5872.81
8- 2-84	1848	214.783	1	1	13.08	13.06	5872.92
8- 2-84	1850	214.785	1	1	13.04	13.02	5872.96
8- 2-84	1853	214.787	1	1	13.02	13.00	5872.98
8- 2-84	1855	214.788	1	1	12.98	12.96	5873.02
8- 2-84	1857	214.790	1	1	12.98	12.96	5873.02
8- 2-84	1900	214.792	1	1	12.94	12.92	5873.06
8- 2-84	1905	214.795	1	1	12.97	12.95	5873.03
8- 2-84	1910	214.799	1	1	12.96	12.94	5873.04
8- 2-84	1915	214.802	1	1	12.95	12.93	5873.05
8- 3-84	1554	215.663	1	1	12.68	12.66	5873.32
8- 4-84	741	216.320	1	1	12.61	12.59	5873.39
8- 6-84	1650	218.701	1	1	12.65	12.63	5873.35
8- 7-84	1804	219.753	1	1	12.95	12.93	5873.05
8- 8-84	1759	220.749	1	1	13.30	13.28	5872.70
8- 9-84	1040	221.444	1	1	13.37	13.35	5872.63
8-10-84	859	222.374	1	1	13.41	13.39	5872.59
8-13-84	1628	225.686	1	1	13.74	13.71	5872.27
8-14-84	951	226.410	1	1	13.72	13.69	5872.29
8-17-84	1132	229.481	1	1	27.47	27.38	5858.60
8-17-84	1423	229.599	1	1	24.41	24.33	5861.65
8-17-84	1515	229.635	1	1	19.44	19.37	5866.61
8-17-84	1649	229.701	1	1	20.34	20.27	5865.71
8-17-84	1730	229.729	1	1	17.81	17.76	5868.22
8-20-84	837	232.359	1	1	14.25	14.22	5871.76
8-21-84	1222	233.515	1	1	25.16	25.07	5860.91
8-22-84	710	234.299	1	1	15.23	15.19	5870.79
8-23-84	1020	235.431	1	2	14.72	14.63	5871.35
8-24-84	843	236.363	1	3	14.45	14.45	5871.53
8-27-84	836	239.358	1	3	14.20	14.20	5871.78
8-28-84	929	240.395	1	3	14.19	14.19	5871.79
8-28-84	1322	240.557	1	3	14.21	14.21	5871.77
8-29-84	1521	241.640	1	3	14.17	14.17	5871.81
8-30-84	1020	242.431	1	3	14.16	14.16	5871.82
8-31-84	1404	243.586	1	2	14.30	14.22	5871.76
9- 4-84	912	247.383	1	3	14.11	14.11	5871.87
9- 6-84	821	249.348	1	2	14.14	14.06	5871.92
9- 7-84	1406	250.588	1	3	14.17	14.17	5871.81
9-10-84	835	253.358	1	3	14.14	14.14	5871.84
9-12-84	1515	255.635	1	3	14.16	14.16	5871.82
9-13-84	1414	256.593	1	3	14.17	14.17	5871.81
9-19-84	800	262.333	1	3	14.25	14.25	5871.73
9-20-84	1519	263.638	1	3	14.17	14.17	5871.81
9-25-84	1310	268.549	1	3	14.17	14.17	5871.81
10- 1-84	1102	274.460	1	3	14.24	14.24	5871.74
10- 4-84	1348	277.575	2	3	14.22	14.22	5872.15
10- 8-84	945	281.406	2	3	14.27	14.27	5872.10
10-15-84	1020	288.431	2	3	14.21	14.21	5872.16
10-17-84	1530	290.646	2	3	14.19	14.19	5872.18
10-22-84	1530	295.646	2	3	14.16	14.16	5872.21
10-25-84	1030	298.438	2	3	13.73	13.73	5872.64
10-27-84	1415	300.594	2	3	14.01	14.01	5872.36
10-29-84	905	302.378	2	3	13.94	13.94	5872.43
11- 1-84	1030	305.438	2	3	14.01	14.01	5872.36
11- 3-84	1300	307.542	2	3	14.06	14.06	5872.31
11- 6-84	1555	310.663	2	3	14.10	14.10	5872.27
11- 9-84	1255	313.538	2	3	14.21	14.21	5872.16

TW-7 (CONT.)

11-16-84	1400	320.583	2	3	14.19	14.19	5872.18
11-19-84	817	323.345	2	3	14.32	14.32	5872.05
11-21-84	847	325.366	2	3	14.30	14.30	5872.07
11-26-84	1634	330.690	2	3	14.40	14.40	5871.97
11-28-84	917	332.387	2	3	14.35	14.35	5872.02
11-30-84	951	334.410	2	3	14.40	14.40	5871.97
12- 3-84	1412	337.592	2	3	14.42	14.42	5871.95
12- 8-84	1635	342.691	2	3	14.47	14.47	5871.90
12-10-84	1005	344.420	2	3	14.43	14.43	5871.94
12-12-84	930	346.396	2	3	14.47	14.47	5871.90
12-14-84	1400	348.583	2	3	14.55	14.55	5871.82
12-15-84	1200	349.500	2	5	14.50	14.50	5871.87
12-16-84	1200	350.500	2	5	14.53	14.53	5871.84
12-18-84	1355	352.580	2	3	14.53	14.53	5871.84
1-28-85	1610	209.674	2	3	14.70	14.70	5871.67
1-30-85	1200	211.500	2	5	14.75	14.75	5871.62
2- 4-85	1315	185.552	2	3	14.80	14.80	5871.57
2-11-85	1040	192.444	2	3	14.80	14.80	5871.57
2-13-85	1115	194.469	2	3	14.85	14.85	5871.52
2-15-85	1055	196.455	2	3	14.94	14.94	5871.43

WATER-LEVEL DATA FOR TEST WELL: TW-8

MEASURING POINT (MP)
1 MP ELEVATION = 5885.72 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
1 GOLDER ELECTRIC PROBE #1
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
4 MONSANTO ELECTRIC PROBE

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
7-26-84	1513	207.634	1	4	11.33	11.33	5874.39
7-27-84	1309	208.548	1	1	11.37	11.36	5874.36
7-28-84	1009	209.423	1	1	11.37	11.36	5874.36
7-30-84	1123	211.474	1	1	11.16	11.15	5874.57
7-30-84	1834	211.774	1	1	11.08	11.07	5874.65
7-31-84	1114	212.468	1	1	10.90	10.89	5874.83
8- 1-84	1242	213.529	1	1	10.67	10.67	5875.05
8- 2-84	1125	214.476	1	1	10.47	10.47	5875.25
8- 3-84	913	215.384	1	1	10.38	10.38	5875.34
8- 3-84	1005	215.420	1	1	10.36	10.36	5875.36
8- 3-84	1008	215.422	1	1	10.37	10.37	5875.35
8- 3-84	1111	215.466	1	1	27.46	27.37	5858.35
8- 3-84	1012	215.425	1	1	45.55	45.45	5840.27
8- 3-84	1013	215.426	1	1	61.06	60.91	5824.81
8- 3-84	1014	215.426	1	1	75.44	75.26	5810.46
8- 3-84	1015	215.427	1	1	80.12	79.94	5805.78
8- 3-84	1016	215.428	1	1	85.99	85.79	5799.93
8- 3-84	1019	215.430	1	1	85.00	84.80	5800.92
8- 3-84	1020	215.431	1	1	84.84	84.64	5801.08
8- 3-84	1021	215.431	1	1	84.69	84.49	5801.23
8- 3-84	1022	215.432	1	1	84.51	84.31	5801.41
8- 3-84	1023	215.433	1	1	84.37	84.17	5801.55
8- 3-84	1024	215.433	1	1	84.31	84.11	5801.61
8- 3-84	1026	215.435	1	1	83.95	83.75	5801.97
8- 3-84	1028	215.436	1	1	83.79	83.60	5802.12
8- 3-84	1030	215.438	1	1	83.46	83.27	5802.45
8- 3-84	1032	215.439	1	1	83.21	83.02	5802.70
8- 3-84	1034	215.440	1	1	82.91	82.72	5803.00
8- 3-84	1036	215.442	1	1	82.66	82.47	5803.25
8- 3-84	1038	215.443	1	1	82.39	82.20	5803.52
8- 3-84	1040	215.444	1	1	82.11	81.92	5803.80
8- 3-84	1045	215.448	1	1	81.38	81.20	5804.52
8- 3-84	1050	215.451	1	1	80.66	80.48	5805.24
8- 3-84	1055	215.455	1	1	80.00	79.82	5805.90
8- 3-84	1100	215.458	1	1	79.33	79.15	5806.57
8- 3-84	1110	215.465	1	1	77.93	77.75	5807.97
8- 3-84	1123	215.474	1	1	76.21	76.03	5809.69
8- 3-84	1200	215.500	1	1	68.45	68.28	5817.44
8- 3-84	1316	215.553	1	1	53.02	52.91	5832.81
8- 3-84	1347	215.574	1	1	47.88	47.78	5837.94
8- 3-84	1423	215.599	1	1	42.50	42.40	5843.32
8- 3-84	1444	215.614	1	1	39.71	39.61	5846.11

TW-8 (CONT.)

8- 3-84	1548	215.658	1	1	32.43	32.33	5853.39
8- 3-84	1645	215.698	1	1	27.42	27.33	5858.39
8- 3-84	1830	215.771	1	1	20.85	20.78	5864.94
8- 4-84	738	216.318	1	1	10.94	10.93	5874.79
8- 5-84	1106	217.463	1	1	10.05	10.05	5875.67
8- 6-84	1010	218.424	1	1	10.09	10.09	5875.63
8- 7-84	1336	219.567	1	1	10.42	10.42	5875.30
8- 8-84	1810	220.757	1	1	10.62	10.62	5875.10
8- 9-84	1058	221.457	1	1	10.74	10.73	5874.99
8- 9-84	1602	221.668	1	1	10.78	10.77	5874.95
8-10-84	929	222.395	1	1	10.85	10.84	5874.88
8-13-84	1234	225.524	1	1	11.15	11.14	5874.58
8-14-84	942	226.404	1	1	11.20	11.19	5874.53
8-14-84	1030	226.438	1	1	11.20	11.19	5874.53
8-15-84	942	227.404	1	1	11.30	11.29	5874.43
8-16-84	905	228.378	1	1	11.30	11.29	5874.43
8-17-84	941	229.403	1	1	11.37	11.36	5874.36
8-17-84	1658	229.707	1	1	16.30	16.26	5869.46
8-17-84	1730	229.729	1	1	16.28	16.24	5869.48
8-20-84	825	232.351	1	1	12.31	12.29	5873.43
8-21-84	821	233.348	1	1	13.55	13.53	5872.19
8-22-84	708	234.297	1	1	14.64	14.61	5871.11
8-22-84	926	234.393	1	1	20.06	19.99	5865.73
8-22-84	1326	234.560	1	1	27.34	27.25	5858.47
8-23-84	1015	235.427	1	2	13.00	12.93	5872.79
8-24-84	854	236.371	1	3	12.70	12.70	5873.02
8-27-84	839	239.360	1	3	12.42	12.42	5873.30
8-27-84	1346	239.574	1	3	12.42	12.42	5873.30
8-28-84	923	240.391	1	3	12.45	12.45	5873.27
8-29-84	1519	241.638	1	3	12.41	12.41	5873.31
8-31-84	1103	243.460	1	2	12.45	12.38	5873.34
9- 4-84	916	247.386	1	3	12.34	12.34	5873.38
9- 6-84	839	249.360	1	2	12.41	12.34	5873.38
9- 7-84	1355	250.580	1	3	12.40	12.40	5873.32
9-10-84	842	253.363	1	3	12.37	12.37	5873.35
9-12-84	1517	255.637	1	3	12.40	12.40	5873.32
9-13-84	1423	256.599	1	3	12.40	12.40	5873.32
9-14-84	1001	257.417	1	3	12.30	12.30	5873.42
9-18-84	806	261.338	1	3	12.47	12.47	5873.25
9-20-84	1512	263.633	1	3	12.43	12.43	5873.29
9-21-84	902	264.376	1	3	12.43	12.43	5873.29
9-25-84	1035	268.441	1	3	12.45	12.45	5873.27
10- 1-84	1108	274.464	1	3	12.50	12.50	5873.22
10- 4-84	1350	277.576	1	3	12.47	12.47	5873.25
10- 8-84	948	281.408	1	3	12.52	12.52	5873.20
10-15-84	1020	288.431	1	3	12.37	12.37	5873.35
10-17-84	1530	290.646	1	3	12.32	12.32	5873.40
10-22-84	1530	295.646	1	3	12.35	12.35	5873.37
10-25-84	1030	298.438	1	3	12.07	12.07	5873.65
10-27-84	1415	300.594	1	3	12.19	12.19	5873.53
10-29-84	905	302.378	1	3	12.12	12.12	5873.60
11- 1-84	1030	305.438	1	3	12.20	12.20	5873.52
11- 3-84	1300	307.542	1	3	12.22	12.22	5873.50
11- 6-84	1555	310.663	1	3	12.22	12.22	5873.50
11- 9-84	1255	313.538	1	3	12.35	12.35	5873.37
11-16-84	1400	320.583	1	3	12.02	12.02	5873.70
11-19-84	817	323.345	1	3	12.17	12.17	5873.55

TW-8 (CONT.)

11-21-84	847	325.366	1	3	12.12	12.12	5873.60
11-26-84	1634	330.690	1	3	12.19	12.19	5873.53
11-28-84	917	332.387	1	3	12.12	12.12	5873.60
11-30-84	957	334.415	1	3	12.15	12.15	5873.57
12- 3-84	1412	337.592	1	3	12.19	12.19	5873.53
12- 8-84	1635	342.691	1	3	12.17	12.17	5873.55
12-10-84	1005	344.420	1	3	12.17	12.17	5873.55
12-12-84	930	346.396	1	3	12.15	12.15	5873.57
12-14-84	1346	348.574	1	3	12.27	12.27	5873.45
12-15-84	1310	349.549	1	3	12.17	12.17	5873.55
12-15-84	1740	349.736	1	3	12.17	12.17	5873.55
12-15-84	1925	349.809	1	3	12.17	12.17	5873.55
12-15-84	2225	349.934	1	3	12.17	12.17	5873.55
12-16-84	40	350.028	1	3	12.17	12.17	5873.55
12-16-84	245	350.115	1	3	12.17	12.17	5873.55
12-16-84	510	350.215	1	3	12.19	12.19	5873.53
12-16-84	720	350.306	1	3	12.17	12.17	5873.55
12-16-84	850	350.368	1	3	12.17	12.17	5873.55
12-16-84	1215	350.510	1	3	12.19	12.19	5873.53
12-17-84	900	351.375	1	3	12.27	12.27	5873.45
1-28-85	1610	209.674	1	3	12.27	12.27	5873.45
1-30-85	735	211.316	1	3	12.30	12.30	5873.42
1-31-85	1130	212.479	1	3	12.40	12.40	5873.32
2- 2-85	850	183.368	1	3	12.40	12.40	5873.32
2- 4-85	1315	185.552	1	3	12.47	12.47	5873.25
2- 6-85	1050	187.451	1	3	12.37	12.37	5873.35
2-11-85	1040	192.444	1	3	12.34	12.34	5873.38
2-13-85	1115	194.469	1	3	12.42	12.42	5873.30
2-15-85	1055	196.455	1	3	12.34	12.34	5873.38

WATER-LEVEL DATA FOR TEST WELL: TW-9

MEASURING POINT (MP)
1 MP ELEVATION = 5885.60 (FT MSL) : TOP OF PVC

MEASURING DEVICE (MD)
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
8-23-84	815	235.344	1	3	6.67	6.67	5878.93
8-24-84	800	236.333	1	3	6.80	6.80	5878.80
8-27-84	824	239.350	1	3	6.67	6.67	5878.93
8-27-84	1655	239.705	1	3	6.68	6.68	5878.92
8-28-84	847	240.366	1	3	6.61	6.61	5878.99
8-29-84	1525	241.642	1	3	6.77	6.77	5878.83
8-30-84	1013	242.426	1	3	6.71	6.71	5878.89
9- 4-84	918	247.388	1	3	6.79	6.79	5878.81
9- 6-84	850	249.368	1	2	6.75	6.73	5878.86
9- 7-84	1600	250.667	1	3	6.76	6.76	5878.84
9-10-84	845	253.365	1	3	6.80	6.80	5878.80
9-11-84	923	254.391	1	1	6.76	6.76	5878.84
9-12-84	1521	255.640	1	3	6.81	6.81	5878.79
9-13-84	1427	256.602	1	3	6.79	6.79	5878.81
9-19-84	809	262.340	1	3	6.89	6.89	5878.71
9-20-84	1516	263.636	1	3	6.73	6.73	5878.87
9-24-84	1050	267.451	1	3	6.82	6.82	5878.78
9-25-84	1030	268.438	1	3	6.86	6.86	5878.74
9-27-84	1435	270.608	1	3	6.82	6.82	5878.78
10- 4-84	1340	277.569	1	3	6.84	6.84	5878.76
10- 8-84	950	281.410	1	3	7.02	7.02	5878.58
10-15-84	1020	288.431	1	3	6.33	6.33	5879.27
10-17-84	1530	290.646	1	3	6.33	6.33	5879.27
10-22-84	1530	295.646	1	3	6.40	6.40	5879.20
10-25-84	1030	298.438	1	3	6.53	6.53	5879.07
10-27-84	1415	300.594	1	3	6.38	6.38	5879.22
10-29-84	905	302.378	1	3	6.40	6.40	5879.20
11- 1-84	1030	305.438	1	3	6.55	6.55	5879.05
11- 3-84	1300	307.542	1	3	6.43	6.43	5879.17
11- 6-84	1555	310.663	1	3	6.45	6.45	5879.15
11- 9-84	1240	313.528	1	3	6.54	6.54	5879.06
11-16-84	1400	320.583	1	3	6.63	6.63	5878.97
11-19-84	821	323.348	1	3	6.63	6.63	5878.97
11-21-84	847	325.366	1	3	6.63	6.63	5878.97
11-26-84	1634	330.690	1	3	6.68	6.68	5878.92
11-28-84	917	332.387	1	3	6.64	6.64	5878.96
11-30-84	951	334.410	1	3	6.68	6.68	5878.92
12- 3-84	1412	337.592	1	3	6.74	6.74	5878.86
12- 8-84	1635	342.691	1	3	6.86	6.86	5878.74
12-10-84	1005	344.420	1	3	6.81	6.81	5878.79
12-12-84	930	346.396	1	3	6.77	6.77	5878.83
12-14-84	1342	348.571	1	3	6.91	6.91	5878.69
12-15-84	1310	349.549	1	3	6.82	6.82	5878.78
12-15-84	1740	349.736	1	3	6.87	6.87	5878.73

TW-9 (CONT.)

12-15-84	1925	349.809	1	3	6.86	6.86	5878.74
12-15-84	2225	349.934	1	3	6.86	6.86	5878.74
12-16-84	40	350.028	1	3	6.87	6.87	5878.73
12-16-84	245	350.115	1	3	6.87	6.87	5878.73
12-16-84	570	350.257	1	3	6.87	6.87	5878.73
12-16-84	720	350.306	1	3	6.87	6.87	5878.73
12-16-84	850	350.368	1	3	6.87	6.87	5878.73
12-16-84	1215	350.510	1	3	6.86	6.86	5878.74
12-17-84	900	351.375	1	3	6.95	6.95	5878.65
1-28-85	1610	209.674	1	3	7.31	7.31	5878.29
1-30-85	735	211.316	1	3	7.87	7.87	5877.73
1-31-85	1130	212.479	1	3	7.48	7.48	5878.12
2- 2-85	850	183.368	1	3	7.70	7.70	5877.90
2- 4-85	1315	185.552	1	3	7.58	7.58	5878.02
2- 6-85	1050	187.451	1	3	7.48	7.48	5878.12
2-11-85	1040	192.444	1	3	7.41	7.41	5878.19
2-13-85	1115	194.469	1	3	7.55	7.55	5878.05
2-15-85	1055	196.455	1	3	7.51	7.51	5878.09

WATER-LEVEL DATA FOR TEST WELL: TW-10

MEASURING POINT (MP)
1 MP ELEVATION = 5886.44 (FT MSL) : TOP OF 4 IN PVC

MEASURING DEVICE (MD)
2 GOLDER ELECTRIC PROBE #2
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
8-31-84	1333	243.565	1	2	14.73	14.64	5871.80
9- 4-84	906	247.379	1	3	14.76	14.76	5871.68
9- 6-84	857	249.373	1	2	14.78	14.69	5871.75
9- 7-84	1414	250.593	1	3	14.76	14.76	5871.68
9-10-84	850	253.368	1	3	14.80	14.80	5871.64
9-11-84	927	254.394	1	3	14.80	14.80	5871.64
9-12-84	1523	255.641	1	3	14.80	14.80	5871.64
9-13-84	1436	256.608	1	3	14.80	14.80	5871.64
9-14-84	1011	257.424	1	3	14.83	14.83	5871.61
9-19-84	812	262.342	1	3	14.91	14.91	5871.53
9-20-84	1201	263.501	1	3	14.93	14.93	5871.51
9-21-84	909	264.381	1	3	14.89	14.89	5871.55
9-24-84	1045	267.448	1	3	14.86	14.86	5871.58
9-27-84	1445	270.615	1	3	14.87	14.87	5871.57
10- 1-84	1100	274.458	1	3	14.91	14.91	5871.53
10- 4-84	1345	277.573	1	3	14.91	14.91	5871.53
10- 8-84	952	281.411	1	3	14.96	14.96	5871.48
10-15-84	1020	288.431	1	3	14.89	14.89	5871.55
10-17-84	1530	290.646	1	3	14.86	14.86	5871.58
10-22-84	1530	295.646	1	3	14.85	14.85	5871.59
10-25-84	1030	298.438	1	3	14.52	14.52	5871.92
10-27-84	1415	300.594	1	3	14.70	14.70	5871.74
10-29-84	905	302.378	1	3	14.60	14.60	5871.84
11- 1-84	1030	305.438	1	3	14.70	14.70	5871.74
11- 3-84	1300	307.542	1	3	14.75	14.75	5871.69
11- 6-84	1400	310.583	1	3	14.80	14.80	5871.64
11- 9-84	1250	313.535	1	3	14.84	14.84	5871.60
11-16-84	1400	320.583	1	3	14.86	14.86	5871.58
11-19-84	821	323.348	1	3	14.91	14.91	5871.53
11-20-84	1115	324.469	1	3	14.91	14.91	5871.53
11-27-84	920	331.389	1	3	15.01	15.01	5871.43
11-29-84	1200	333.500	1	5	15.00	15.00	5871.44
11-30-84	957	334.415	1	3	14.99	14.99	5871.45
12- 2-84	1200	336.500	1	5	15.02	15.02	5871.42
12- 4-84	1345	338.573	1	5	15.04	15.04	5871.40
12- 6-84	1200	340.500	1	5	15.06	15.06	5871.38
12- 8-84	1200	342.500	1	5	15.04	15.04	5871.40
12-11-84	1315	345.552	1	3	15.06	15.06	5871.38
12-14-84	1345	348.573	1	3	15.09	15.09	5871.35
12-15-84	1310	349.549	1	3	15.04	15.04	5871.40
12-16-84	1110	350.465	1	3	15.04	15.04	5871.40
12-17-84	1135	351.483	1	3	15.07	15.07	5871.37
1-28-85	1600	209.667	1	3	15.19	15.19	5871.25

TW-10 (CONT.)

1-30-85	1200	211.500	1	5	15.19	15.19	5871.25
2- 1-85	1200	182.500	1	5	15.18	15.18	5871.26
2- 4-85	1315	185.552	1	3	15.21	15.21	5871.23
2- 6-85	1200	187.500	1	5	15.21	15.21	5871.23
2- 8-85	1200	189.500	1	5	15.20	15.20	5871.24
2-11-85	1040	192.444	1	3	15.22	15.22	5871.22
2-13-85	1115	194.469	1	3	15.27	15.27	5871.17
2-15-85	1100	196.458	1	3	15.25	15.25	5871.19

WATER-LEVEL DATA FOR TEST WELL: TW-11

MEASURING POINT (MP)
1 MP ELEVATION = 5938.82 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-12-84	1000	255.417	1	3	66.10	66.10	5872.72
9-13-84	825	256.351	1	3	66.11	66.11	5872.71
9-14-84	719	257.305	1	3	66.11	66.11	5872.71
9-14-84	1405	257.587	1	3	66.03	66.03	5872.79
9-15-84	830	258.354	1	3	65.96	65.96	5872.86
9-17-84	854	260.371	1	3	65.65	65.65	5873.17
9-19-84	857	262.373	1	3	65.52	65.52	5873.30
9-20-84	1657	263.706	1	3	65.37	65.37	5873.45
9-24-84	1015	267.427	1	3	65.25	65.25	5873.57
9-26-84	1115	269.469	1	3	65.22	65.22	5873.60
9-27-84	1415	270.594	1	3	65.22	65.22	5873.60
10- 1-84	844	274.364	1	3	65.29	65.29	5873.53
10- 8-84	840	281.361	1	3	65.67	65.67	5873.15
10- 9-84	845	282.365	1	3	65.63	65.63	5873.19
10-12-84	830	285.354	1	3	65.60	65.60	5873.22
10-15-84	1000	288.417	1	3	65.53	65.53	5873.29
10-17-84	1540	290.653	1	3	65.48	65.48	5873.34
10-22-84	930	295.396	1	3	65.39	65.39	5873.43
10-25-84	1100	298.458	1	3	65.30	65.30	5873.52
10-27-84	1445	300.615	1	3	65.27	65.27	5873.55
10-29-84	915	302.385	1	3	65.39	65.39	5873.43
11- 1-84	1015	305.427	1	3	65.52	65.52	5873.30
11- 3-84	1350	307.576	1	3	65.45	65.45	5873.37
11- 6-84	1525	310.642	1	3	65.57	65.57	5873.25
11-12-84	1105	316.462	1	3	65.78	65.78	5873.04
11-16-84	1412	320.592	1	3	65.75	65.75	5873.07
11-19-84	840	323.361	1	3	65.78	65.78	5873.04
11-21-84	907	325.380	1	3	65.81	65.81	5873.01
11-26-84	1645	330.698	1	3	65.88	65.88	5872.94
11-28-84	932	332.397	1	3	65.91	65.91	5872.91
11-30-84	1013	334.426	1	3	66.01	66.01	5872.81
12- 3-84	1440	337.611	1	3	66.14	66.14	5872.68
12- 8-84	1610	342.674	1	3	66.27	66.27	5872.55
12-10-84	1015	344.427	1	3	66.30	66.30	5872.52
12-12-84	1140	346.486	1	3	66.26	66.26	5872.56
12-15-84	1241	349.528	1	3	66.39	66.39	5872.43
12-15-84	1705	349.712	1	3	66.40	66.40	5872.42
12-15-84	1925	349.809	1	3	66.39	66.39	5872.43
12-15-84	2235	349.941	1	3	66.40	66.40	5872.42
12-16-84	30	350.021	1	3	66.40	66.40	5872.42
12-16-84	255	350.122	1	3	66.40	66.40	5872.42
12-16-84	500	350.208	1	3	66.40	66.40	5872.42
12-16-84	705	350.295	1	3	66.42	66.42	5872.40
12-16-84	835	350.358	1	3	66.42	66.42	5872.40
12-16-84	1030	350.438	1	3	66.40	66.40	5872.42

TW-11 (CONT.)

12-16-84	1205	350.503	1	3	66.40	66.40	5872.42
12-17-84	915	351.385	1	3	66.60	66.60	5872.22
1-29-85	1200	210.500	1	3	67.06	67.06	5871.76
1-31-85	1050	212.451	1	3	67.01	67.01	5871.81
2- 2-85	915	183.385	1	3	66.93	66.93	5871.89
2- 4-85	1135	185.483	1	3	66.85	66.85	5871.97
2- 6-85	1030	187.438	1	3	66.76	66.76	5872.06
2-11-85	935	192.399	1	3	67.09	67.09	5871.73
2-13-85	1140	194.486	1	3	67.39	67.39	5871.43
2-15-85	815	196.344	1	3	67.49	67.49	5871.33

WATER-LEVEL DATA FOR TEST WELL: TW-12

MEASURING POINT (MP)
1 MP ELEVATION = 5940.13 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-17-84	845	260.365	1	3	67.49	67.49	5872.64
9-19-84	841	262.362	1	3	67.37	67.37	5872.76
9-20-84	1654	263.704	1	3	67.22	67.22	5872.91
9-24-84	1010	267.424	1	3	67.06	67.06	5873.07
9-26-84	1105	269.462	1	3	67.04	67.04	5873.09
9-27-84	1410	270.590	1	3	67.04	67.04	5873.09
10- 1-84	855	274.372	1	3	67.16	67.16	5872.97
10- 4-84	1115	277.469	1	3	67.27	67.27	5872.86
10- 9-84	845	282.365	1	3	67.45	67.45	5872.68
10-12-84	830	285.354	1	3	67.42	67.42	5872.71
10-15-84	1000	288.417	1	3	67.34	67.34	5872.79
10-17-84	1540	290.653	1	3	67.29	67.29	5872.84
10-22-84	930	295.396	1	3	67.19	67.19	5872.94
10-25-84	1100	298.458	1	3	67.10	67.10	5873.03
10-27-84	1445	300.615	1	3	67.06	67.06	5873.07
10-29-84	915	302.385	1	3	67.19	67.19	5872.94
11- 1-84	1015	305.427	1	3	67.33	67.33	5872.80
11- 3-84	1300	307.542	1	3	67.29	67.29	5872.84
11- 6-84	1525	310.642	1	3	67.39	67.39	5872.74
11-12-84	1055	316.455	1	3	67.58	67.58	5872.55
11-16-84	1412	320.592	1	3	67.58	67.58	5872.55
11-19-84	840	323.361	1	3	67.62	67.62	5872.51
11-21-84	907	325.380	1	3	67.63	67.63	5872.50
11-23-84	800	327.333	1	5	67.85	67.85	5872.28
11-25-84	1200	329.500	1	5	67.80	67.80	5872.33
11-27-84	1200	331.500	1	5	68.03	68.03	5872.10
11-28-84	939	332.402	1	3	67.73	67.73	5872.40
11-30-84	1200	334.500	1	5	67.87	67.87	5872.26
12- 2-84	1200	336.500	1	5	68.01	68.01	5872.12
12- 3-84	1330	337.563	1	5	68.09	68.09	5872.04
12- 4-84	1325	338.559	1	5	68.09	68.09	5872.04
12- 6-84	1200	340.500	1	5	68.11	68.11	5872.02
12- 8-84	1200	342.500	1	5	68.12	68.12	5872.01
12-10-84	1200	344.500	1	5	68.16	68.16	5871.97
12-11-84	1400	345.583	1	3	68.14	68.14	5871.99
12-13-84	1200	347.500	1	5	68.15	68.15	5871.98
12-15-84	1200	349.500	1	5	68.28	68.28	5871.85
12-17-84	1440	351.611	1	3	68.39	68.39	5871.74
1-29-85	1200	210.500	1	3	68.90	68.90	5871.23
1-31-85	1050	212.451	1	3	68.86	68.86	5871.27
2- 2-85	915	183.385	1	3	68.73	68.73	5871.40
2- 4-85	1135	185.483	1	3	68.68	68.68	5871.45
2- 6-85	1030	187.438	1	3	68.60	68.60	5871.53
2-11-85	935	192.399	1	3	68.99	68.99	5871.14

TW-12 (CONT.)

2-13-85	1140	194.486	1	3	69.26	69.26	5870.87
2-15-85	815	196.344	1	3	69.31	69.31	5870.82

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW17A
Laboratory Number:	75951
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.97
Eh (millivolts)	130
Conductivity (micromhos/cm)	20

Laboratory Measurements	
pH (standard units)	6.7
Conductivity (micromhos/cm)	23
Total Alkalinity (mg of CaCO3/l)	7
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	24
Sodium Adsorption Ratio	0.16
Total Hardness (mg of CaCO3/l)	7
Ionic Strength	<2.79E-04

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.08E-04	1.07E-04	
Calcium (Ca)	<	1	4.99E-02	2.50E-05
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)	<	1	4.35E-02	4.35E-05
Potassium (K)	<	1	2.56E-02	2.56E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		5	2.39E-01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		9	1.40E-01	1.40E-04
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)	<	1	2.82E-02	2.82E-05
Fluoride (F)		0.1	5.26E-03	5.26E-06
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)	<	1	2.08E-02	1.04E-05
Dissolved Silica (H4SiO4)		12.66		1.32E-04
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		23	1.98E-01	

Dissolved Solid Ratio	1.18
Cation-Anion Balance	9.55%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW21A
Laboratory Number:	76010
Date Sampled:	11-13-84

Field Measurements	
Temperature(C)	18
pH (standard units)	8.38
Eh (millivolts)	110
Conductivity (micromhos/cm)	12

Laboratory Measurements	
pH (standard units)	6.1
Conductivity (micromhos/cm)	8
Total Alkalinity (mg of CaCO3/l)	11
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	4
Sodium Adsorption Ratio	0.86
Total Hardness (mg of CaCO3/l)	7
Ionic Strength	<4.06E-04

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.20E-06	4.17E-06	
Calcium (Ca)	<	1	4.99E-02	2.50E-05
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)		5	2.17E-01	2.17E-04
Potassium (K)	<	1	2.56E-02	2.56E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)		0.006	2.31E-04	1.15E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		9	4.13E-01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		13	2.20E-01	2.20E-04
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		1	2.82E-02	2.82E-05
Fluoride (F)	<	0.1	5.26E-03	5.26E-06
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)	<	1	2.08E-02	1.04E-05
Dissolved Silica (H4SiO4)	<	0.3		3.12E-06
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		16	2.78E-01	

Dissolved Solid Ratio	6.19
Cation-Anion Balance	19.58%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW2
Laboratory Number:	77450
Date Sampled:	2-21-85

Field Measurements	
Temperature(C)	19
pH (standard units)	6.71
Eh (millivolts)	197
Conductivity (micromhos/cm)	700

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	1020
Total Alkalinity (mg of CaCO3/l)	430
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	709
Sodium Adsorption Ratio	0.27
Total Hardness (mg of CaCO3/l)	514
Ionic Strength	1.66E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.97E-04	1.95E-04	
Calcium (Ca)		112	5.59E+00	2.79E-03
Magnesium (Mg)		57	4.69E+00	2.34E-03
Sodium (Na)		14	6.09E-01	6.09E-04
Potassium (K)		5	1.28E-01	1.28E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.58	1.77E-02	8.87E-06
Ammonium (NH4)				
Total		189	1.10E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	524	8.59E+00	8.59E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	21	5.92E-01	5.92E-04
Fluoride (F)	0.27	1.42E-02	1.42E-05
Nitrate + Nitrite (NOX)	18.43	3.41E-01	3.41E-04
Sulfate (SO4)	56	1.17E+00	5.83E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	620	1.07E+01	

Dissolved Solid Ratio	1.14
Cation-Anion Balance	1.53%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW3
Laboratory Number:	77451
Date Sampled:	2-27-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.03
Eh (millivolts)	6
Conductivity (micromhos/cm)	1110

Laboratory Measurements	
pH (standard units)	6.5
Conductivity (micromhos/cm)	1710
Total Alkalinity (mg of CaCO3/l)	954
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1240
Sodium Adsorption Ratio	0.46
Total Hardness (mg of CaCO3/l)	912
Ionic Strength	3.20E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		9.41E-04	9.33E-04	
Calcium (Ca)		118	5.89E+00	2.94E-03
Magnesium (Mg)		150	1.23E+01	6.17E-03
Sodium (Na)		32	1.39E+00	1.39E-03
Potassium (K)		14	3.58E-01	3.58E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		15.10	6.76E-01	2.70E-04
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.27	9.83E-03	4.91E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.05	1.53E-03	7.65E-07
Ammonium (NH4)				
Total		330	2.07E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1163	1.91E+01	1.91E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		30	8.46E-01	8.46E-04
Fluoride (F)		0.4	2.11E-02	2.11E-05
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)		98	2.04E+00	1.02E-03
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1292	2.20E+01	

Dissolved Solid Ratio	1.31
Cation-Anion Balance	3.06%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW4
Laboratory Number:	77452
Date Sampled:	2-27-85

Field Measurements	
Temperature(C)	12
pH (standard units)	6.14
Eh (millivolts)	7
Conductivity (micromhos/cm)	900

Laboratory Measurements	
pH (standard units)	6.7
Conductivity (micromhos/cm)	1880
Total Alkalinity (mg of CaCO3/l)	1020
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1250
Sodium Adsorption Ratio	0.49
Total Hardness (mg of CaCO3/l)	1036
Ionic Strength	3.52E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		7.30E-04	7.24E-04	
Calcium (Ca)		128	6.39E+00	3.19E-03
Magnesium (Mg)		174	1.43E+01	7.16E-03
Sodium (Na)		36	1.57E+00	1.57E-03
Potassium (K)		16	4.09E-01	4.09E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		15.50	6.94E-01	2.78E-04
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.60	2.18E-02	1.09E-05
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.08	2.45E-03	1.22E-06
Ammonium.(NH4)				
Total		370	2.34E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1243	2.04E+01	2.04E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		27	7.62E-01	7.62E-04
Fluoride (F)		0.4	2.11E-02	2.11E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		96	2.00E+00	9.99E-04
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1367	2.32E+01	

Dissolved Solid Ratio	1.39
Cation-Anion Balance	0.50%

...y Analysis

Monsanto, Inc.
Soda Springs Plant

Identification:	TW5
Laboratory Number:	77261
Date Sampled:	2-19-85

Field Measurements

Temperature(C)	14
pH (standard units)	6.72
Eh (millivolts)	32
Conductivity (micromhos/cm)	1550

Laboratory Measurements

pH (standard units)	6.8
Conductivity (micromhos/cm)	2870
Total Alkalinity (mg of CaCO3/l)	314
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1900
Sodium Adsorption Ratio	2.44
Total Hardness (mg of CaCO3/l)	867
Ionic Strength	4.32E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.92E-04	1.91E-04	
Calcium (Ca)		166	8.28E+00	4.14E-03
Magnesium (Mg)		110	9.05E+00	4.52E-03
Sodium (Na)		165	7.18E+00	7.18E-03
Potassium (K)		130	3.32E+00	3.32E-03
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)		0.348	6.19E-03	3.10E-06
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		4.48	1.63E-01	8.15E-05
Selenium (Se)		0.010		1.27E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		1.16	3.55E-02	1.77E-05
Ammonium (NH4)				
Total		577	2.80E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	383	6.27E+00	6.27E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	230	6.49E+00	6.49E-03
Fluoride (F)	12.3	6.47E-01	6.47E-04
Nitrate + Nitrite (NOX)	45.1	8.35E-01	8.35E-04
Sulfate (SO4)	640	1.33E+01	6.66E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1310	2.76E+01	

Dissolved Solid Ratio	0.99
Cation-Anion Balance	0.85%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW6
Laboratory Number:	77262
Date Sampled:	2-19-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.92
Eh (millivolts)	13
Conductivity (micromhos/cm)	1550

Laboratory Measurements	
pH (standard units)	7.0
Conductivity (micromhos/cm)	2660
Total Alkalinity (mg of CaCO3/l)	355
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1870
Sodium Adsorption Ratio	2.48
Total Hardness (mg of CaCO3/l)	882
Ionic Strength	4.37E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.21E-04	1.20E-04	
Calcium (Ca)	172	8.58E+00	4.29E-03
Magnesium (Mg)	110	9.05E+00	4.52E-03
Sodium (Na)	169	7.35E+00	7.35E-03
Potassium (K)	129	3.30E+00	3.30E-03
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.007	1.25E-04	6.23E-08
Chromium (Cr)	0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	1.95	8.73E-02	3.49E-05
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	5.68	2.07E-01	1.03E-04
Selenium (Se)	0.026		3.29E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	1.48	4.53E-02	2.26E-05
Ammonium (NH4)			
Total	589	2.86E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	433	7.09E+00	7.09E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	230	6.49E+00	6.49E-03
Fluoride (F)	14.4	7.58E-01	7.58E-04
Nitrate + Nitrite (NOX)	38.51	7.13E-01	7.13E-04
Sulfate (SO4)	622	1.30E+01	6.48E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1338	2.80E+01	

Dissolved Solid Ratio	1.03
Cation-Anion Balance	1.09%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW7
Laboratory Number:	77453
Date Sampled:	2-27-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.34
Eh (millivolts)	97
Conductivity (micromhos/cm)	1230

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	1820
Total Alkalinity (mg of CaCO3/l)	979
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1210
Sodium Adsorption Ratio	0.53
Total Hardness (mg of CaCO3/l)	1065
Ionic Strength	3.50E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.61E-04	4.57E-04	
Calcium (Ca)		100	4.99E+00	2.50E-03
Magnesium (Mg)		198	1.63E+01	8.14E-03
Sodium (Na)		40	1.74E+00	1.74E-03
Potassium (K)		20	5.12E-01	5.12E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		4.03	1.80E-01	7.22E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.23	8.37E-03	4.19E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		362	2.37E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1193	1.96E+01	1.96E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		40	1.13E+00	1.13E-03
Fluoride (F)		0.37	1.95E-02	1.95E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		98	2.04E+00	1.02E-03
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1332	2.27E+01	

Dissolved Solid Ratio	1.40
Cation-Anion Balance	2.08%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW8
Laboratory Number:	77455
Date Sampled:	2-27-85

Field Measurements	
Temperature(C)	13
pH (standard units)	6.28
Eh (millivolts)	27
Conductivity (micromhos/cm)	1600

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	2430
Total Alkalinity (mg of CaCO3/l)	1490
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1620
Sodium Adsorption Ratio	0.59
Total Hardness (mg of CaCO3/l)	1439
Ionic Strength	4.64E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	5.29E-04	5.25E-04	
Calcium (Ca)	54	2.69E+00	1.35E-03
Magnesium (Mg)	317	2.61E+01	1.30E-02
Sodium (Na)	51	2.22E+00	2.22E-03
Potassium (K)	22	5.63E-01	5.63E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	3.95	1.77E-01	7.07E-05
Lead (Pb)	0.03	2.90E-04	1.45E-07
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.07	2.14E-03	1.07E-06
Ammonium (NH4)			
Total	448	3.17E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	1816	2.98E+01	2.98E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	16	4.51E-01	4.51E-04
Fluoride (F)	0.32	1.68E-02	1.68E-05
Nitrate + Nitrite (NOX)	< 0.19	3.57E-03	3.57E-06
Sulfate (SO4)	44	9.16E-01	4.58E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1877	3.12E+01	

Dissolved Solid Ratio	1.44
Cation-Anion Balance	0.91%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW9
Laboratory Number:	77456
Date Sampled:	2-27-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.15
Eh (millivolts)	87
Conductivity (micromhos/cm)	1350

Laboratory Measurements	
pH (standard units)	6.7
Conductivity (micromhos/cm)	1930
Total Alkalinity (mg of CaCO3/l)	1060
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1270
Sodium Adsorption Ratio	0.52
Total Hardness (mg of CaCO3/l)	1103
Ionic Strength	3.67E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		7.14E-04	7.08E-04	
Calcium (Ca)		150	7.49E+00	3.74E-03
Magnesium (Mg)		177	1.46E+01	7.28E-03
Sodium (Na)		40	1.74E+00	1.74E-03
Potassium (K)		16	4.09E-01	4.09E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		8.76	3.92E-01	1.57E-04
Lead (Pb)		0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.42	1.53E-02	7.64E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.05	1.53E-03	7.65E-07
Ammonium (NH4)				
Total		392	2.46E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1292	2.12E+01	2.12E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		27	7.62E-01	7.62E-04
Fluoride (F)		0.42	2.21E-02	2.21E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		102	2.12E+00	1.06E-03
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1422	2.41E+01	

Dissolved Solid Ratio	1.43
Cation-Anion Balance	1.06%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW10
Laboratory Number:	77457
Date Sampled:	2-21-85

Field Measurements	
Temperature(C)	12
pH (standard units)	6.69
Eh (millivolts)	180
Conductivity (micromhos/cm)	850

Laboratory Measurements	
pH (standard units)	7.6
Conductivity (micromhos/cm)	1520
Total Alkalinity (mg of CaCO3/l)	648
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1020
Sodium Adsorption Ratio	0.84
Total Hardness (mg of CaCO3/l)	774
Ionic Strength	2.71E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		2.06E-04	2.04E-04	
Calcium (Ca)		114	5.69E+00	2.84E-03
Magnesium (Mg)		119	9.79E+00	4.90E-03
Sodium (Na)		54	2.35E+00	2.35E-03
Potassium (K)		14	3.58E-01	3.58E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.53	1.93E-02	9.65E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.04	1.22E-03	6.12E-07
Ammonium (NH4)				
Total		302	1.82E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	790	1.29E+01	1.29E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	107	3.02E+00	3.02E-03
Fluoride (F)	1.17	6.16E-02	6.16E-05
Nitrate + Nitrite (NOX)	9.48	1.76E-01	1.76E-04
Sulfate (SO4)	101	2.10E+00	1.05E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1009	1.83E+01	

Dissolved Solid Ratio	1.28
Cation-Anion Balance	0.27%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW11
Laboratory Number:	77458
Date Sampled:	2-28-85

Field Measurements	
Temperature(C)	20
pH (standard units)	7.49
Eh (millivolts)	70
Conductivity (micromhos/cm)	1230

Laboratory Measurements	
pH (standard units)	7.7
Conductivity (micromhos/cm)	1450
Total Alkalinity (mg of CaCO3/l)	422
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1020
Sodium Adsorption Ratio	1.78
Total Hardness (mg of CaCO3/l)	606
Ionic Strength	2.43E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	3.26E-05	3.24E-05	
Calcium (Ca)	147	7.34E+00	3.67E-03
Magnesium (Mg)	58	4.77E+00	2.39E-03
Sodium (Na)	101	4.39E+00	4.39E-03
Potassium (K)	7	1.79E-01	1.79E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	313	1.67E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	514	8.43E+00	8.43E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	107	3.02E+00	3.02E-03
Fluoride (F)	0.27	1.42E-02	1.42E-05
Nitrate + Nitrite (NOX)	17.46	3.23E-01	3.23E-04
Sulfate (SO4)	195	4.06E+00	2.03E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	834	1.58E+01	

Dissolved Solid Ratio	1.12
Cation-Anion Balance	2.57%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW16
Laboratory Number:	77462
Date Sampled:	2-22-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.78
Eh (millivolts)	120
Conductivity (micromhos/cm)	875

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1710
Total Alkalinity (mg of CaCO3/l)	514
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1090
Sodium Adsorption Ratio	1.8
Total Hardness (mg of CaCO3/l)	643
Ionic Strength	2.64E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.67E-04	1.66E-04	
Calcium (Ca)	124	6.19E+00	3.09E-03
Magnesium (Mg)	81	6.66E+00	3.33E-03
Sodium (Na)	105	4.57E+00	4.57E-03
Potassium (K)	14	3.58E-01	3.58E-04
Arsenic (As)	0.027		3.60E-07
Cadmium (Cd)	1.490	2.65E-02	1.33E-05
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	0.03	2.90E-04	1.45E-07
Manganese (Mn)	0.20	7.28E-03	3.64E-06
Selenium (Se)	0.173		2.19E-06
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.24		4.71E-06
Zinc (Zn)	5.71	1.75E-01	8.73E-05
Ammonium (NH4)			
Total	332	1.80E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	627	1.03E+01	1.03E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	115	3.24E+00	3.24E-03
Fluoride (F)	8.05	4.24E-01	4.24E-04
Nitrate + Nitrite (NOX)	9.92	1.84E-01	1.84E-04
Sulfate (SO4)	194	4.04E+00	2.02E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	954	1.82E+01	

Dissolved Solid Ratio	1.18
Cation-Anion Balance	0.48%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW17
Laboratory Number:	77463
Date Sampled:	2-25-85

Field Measurements	
Temperature(C)	13
pH (standard units)	6.45
Eh (millivolts)	18
Conductivity (micromhos/cm)	1050

Laboratory Measurements	
pH (standard units)	7.7
Conductivity (micromhos/cm)	2150
Total Alkalinity (mg of CaCO3/l)	349
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1410
Sodium Adsorption Ratio	2.02
Total Hardness (mg of CaCO3/l)	835
Ionic Strength	3.44E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.58E-04	3.55E-04	
Calcium (Ca)		61	3.04E+00	1.52E-03
Magnesium (Mg)		166	1.37E+01	6.83E-03
Sodium (Na)		134	5.83E+00	5.83E-03
Potassium (K)		21	5.37E-01	5.37E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)		0.027	4.80E-04	2.40E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)		0.02	1.93E-04	9.65E-08
Manganese (Mn)		1.29	4.70E-02	2.35E-05
Selenium (Se)		0.012		1.52E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.1	3.06E-03	1.53E-06
Ammonium (NH4)				
Total		384	2.31E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	425	6.97E+00	6.97E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	302	8.52E+00	8.52E-03
Fluoride (F)	6.61	3.48E-01	3.48E-04
Nitrate + Nitrite (NOX)	1.43	2.64E-02	2.64E-05
Sulfate (SO4)	316	6.58E+00	3.29E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1051	2.24E+01	

Dissolved Solid Ratio	1.02
Cation-Anion Balance	1.47%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW12
Laboratory Number:	77459
Date Sampled:	2-28-85

Field Measurements	
Temperature(C)	20
pH (standard units)	7.6
Eh (millivolts)	83
Conductivity (micromhos/cm)	2325

Laboratory Measurements	
pH (standard units)	7.7
Conductivity (micromhos/cm)	2770
Total Alkalinity (mg of CaCO3/l)	414
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1770
Sodium Adsorption Ratio	5.14
Total Hardness (mg of CaCO3/l)	724
Ionic Strength	4.22E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	2.53E-05	2.51E-05	
Calcium (Ca)	178	8.88E+00	4.44E-03
Magnesium (Mg)	68	5.59E+00	2.80E-03
Sodium (Na)	318	1.38E+01	1.38E-02
Potassium (K)	8	2.05E-01	2.05E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.08	2.91E-03	1.46E-06
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.67		1.32E-05
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	573	2.85E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	505	8.27E+00	8.27E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	302	8.52E+00	8.52E-03
Fluoride (F)	0.28	1.47E-02	1.47E-05
Nitrate + Nitrite (NOX)	33.38	6.18E-01	6.18E-04
Sulfate (SO4)	574	1.20E+01	5.98E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1414	2.94E+01	

Dissolved Solid Ratio	1.12
Cation-Anion Balance	1.48%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW13
Laboratory Number:	77263
Date Sampled:	2-19-85

Field Measurements	
Temperature(C)	15
pH (standard units)	7.12
Eh (millivolts)	93
Conductivity (micromhos/cm)	625

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	900
Total Alkalinity (mg of CaCO3/l)	411
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	512
Sodium Adsorption Ratio	0.12
Total Hardness (mg of CaCO3/l)	489
Ionic Strength	1.52E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		7.65E-05	7.59E-05	
Calcium (Ca)		120	5.99E+00	2.99E-03
Magnesium (Mg)		46	3.78E+00	1.89E-03
Sodium (Na)		6	2.61E-01	2.61E-04
Potassium (K)		3	7.67E-02	7.67E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.06	2.18E-03	1.09E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.03	9.18E-04	4.59E-07
Ammonium (NH4)				
Total		175	1.01E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	501	8.21E+00	8.21E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	10	2.82E-01	2.82E-04
Fluoride (F)	0.45	2.37E-02	2.37E-05
Nitrate + Nitrite (NOX)	14.61	2.71E-01	2.71E-04
Sulfate (SO4)	43	8.95E-01	4.48E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	569	9.68E+00	

Dissolved Solid Ratio	1.45
Cation-Anion Balance	2.19%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW14
Laboratory Number:	77460
Date Sampled:	2-21-85

Field Measurements	
Temperature(C)	11
pH (standard units)	7.1
Eh (millivolts)	214
Conductivity (micromhos/cm)	450

Laboratory Measurements	
pH (standard units)	7.6
Conductivity (micromhos/cm)	850
Total Alkalinity (mg of CaCO3/l)	387
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	532
Sodium Adsorption Ratio	0.17
Total Hardness (mg of CaCO3/l)	424
Ionic Strength	1.32E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	8.01E-05	7.94E-05	
Calcium (Ca)	104	5.19E+00	2.59E-03
Magnesium (Mg)	40	3.29E+00	1.65E-03
Sodium (Na)	8	3.48E-01	3.48E-04
Potassium (K)	2	5.12E-02	5.12E-05
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	0.08	3.58E-03	1.43E-06
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	154	8.89E+00	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	472	7.73E+00	7.73E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	8	2.26E-01	2.26E-04
Fluoride (F)	0.35	1.84E-02	1.84E-05
Nitrate + Nitrite (NOX)	14.26	2.64E-01	2.64E-04
Sulfate (SO4)	18	3.75E-01	1.87E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	512	8.61E+00	

Dissolved Solid Ratio	1.25
Cation-Anion Balance	1.55%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW15
Laboratory Number:	77264
Date Sampled:	2-19-85

Field Measurements	
Temperature(C)	14
pH (standard units)	7.7
Eh (millivolts)	89
Conductivity (micromhos/cm)	525

Laboratory Measurements	
pH (standard units)	8.1
Conductivity (micromhos/cm)	867
Total Alkalinity (mg of CaCO3/l)	426
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	480
Sodium Adsorption Ratio	0.12
Total Hardness (mg of CaCO3/l)	509
Ionic Strength	1.58E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		2.01E-05	2.00E-05	
Calcium (Ca)		133	6.64E+00	3.32E-03
Magnesium (Mg)		43	3.54E+00	1.77E-03
Sodium (Na)		6	2.61E-01	2.61E-04
Potassium (K)		3	7.67E-02	7.67E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		185	1.05E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	519	8.51E+00	8.51E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	11	3.10E-01	3.10E-04
Fluoride (F)	0.74	3.89E-02	3.89E-05
Nitrate + Nitrite (NOX)	14.61	2.71E-01	2.71E-04
Sulfate (SO4)	43	8.95E-01	4.48E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	589	1.00E+01	

Dissolved Solid Ratio	1.61
Cation-Anion Balance	2.39%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW18
Laboratory Number:	77464
Date Sampled:	2-22-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.28
Eh (millivolts)	34
Conductivity (micromhos/cm)	950

Laboratory Measurements	
pH (standard units)	6.7
Conductivity (micromhos/cm)	1820
Total Alkalinity (mg of CaCO3/l)	1030
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1180
Sodium Adsorption Ratio	0.51
Total Hardness (mg of CaCO3/l)	1009
Ionic Strength	3.27E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.29E-04	5.25E-04	
Calcium (Ca)		81	4.04E+00	2.02E-03
Magnesium (Mg)		196	1.61E+01	8.06E-03
Sodium (Na)		37	1.61E+00	1.61E-03
Potassium (K)		16	4.09E-01	4.09E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)		0.006	1.07E-04	5.34E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		5.68	2.54E-01	1.02E-04
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.16	5.82E-03	2.91E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.03	9.18E-04	4.59E-07
Ammonium (NH4)				
Total		336	2.24E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1256	2.06E+01	2.06E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		20	5.64E-01	5.64E-04
Fluoride (F)		0.32	1.68E-02	1.68E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		32	6.66E-01	3.33E-04
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1308	2.18E+01	

Dissolved Solid Ratio	1.39
Cation-Anion Balance	1.39%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	PW1
Laboratory Number:	77488
Date Sampled:	2-26-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.84
Eh (millivolts)	87
Conductivity (micromhos/cm)	830

Laboratory Measurements	
pH (standard units)	7.1
Conductivity (micromhos/cm)	1380
Total Alkalinity (mg of CaCO3/l)	419
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	922
Sodium Adsorption Ratio	1.21
Total Hardness (mg of CaCO3/l)	629
Ionic Strength	2.39E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.46E-04	1.45E-04	
Calcium (Ca)		135	6.74E+00	3.37E-03
Magnesium (Mg)		71	5.84E+00	2.92E-03
Sodium (Na)		70	3.04E+00	3.04E-03
Potassium (K)		19	4.86E-01	4.86E-04
Arsenic (As)		0.008		1.07E-07
Cadmium (Cd)		0.201	3.58E-03	1.79E-06
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)		0.025		3.17E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.24	7.34E-03	3.67E-06
Ammonium (NH4)				
Total		296	1.61E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	511	8.37E+00	8.37E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	109	3.07E+00	3.07E-03
Fluoride (F)	1.6	8.42E-02	8.42E-05
Nitrate + Nitrite (NOX)	25.14	4.65E-01	4.65E-04
Sulfate (SO4)	172	3.58E+00	1.79E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	819	1.56E+01	

Dissolved Solid Ratio	1.21
Cation-Anion Balance	1.72%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	PW2
Laboratory Number:	77489
Date Sampled:	2-26-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.56
Eh (millivolts)	39
Conductivity (micromhos/cm)	650

Laboratory Measurements	
pH (standard units)	7.1
Conductivity (micromhos/cm)	1260
Total Alkalinity (mg of CaCO3/l)	416
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	754
Sodium Adsorption Ratio	0.69
Total Hardness (mg of CaCO3/l)	572
Ionic Strength	1.97E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	2.78E-04	2.75E-04	
Calcium (Ca)	127	6.34E+00	3.17E-03
Magnesium (Mg)	62	5.10E+00	2.55E-03
Sodium (Na)	38	1.65E+00	1.65E-03
Potassium (K)	10	2.56E-01	2.56E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.027	4.80E-04	2.40E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	0.009		1.14E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.02	6.12E-04	3.06E-07
Ammonium (NH4)		0.00E+00	0.00E+00
Total	237	1.34E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	507	8.31E+00	8.31E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	58	1.64E+00	1.64E-03
Fluoride (F)	0.79	4.16E-02	4.16E-05
Nitrate + Nitrite (NOX)	23.52	4.35E-01	4.35E-04
Sulfate (SO4)	100	2.08E+00	1.04E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	689	1.25E+01	

Dissolved Solid Ratio	1.23
Cation-Anion Balance	3.27%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	PW3
Laboratory Number:	77490
Date Sampled:	2-23-85

Field Measurements	
Temperature(C)	16
pH (standard units)	6.45
Eh (millivolts)	166
Conductivity (micromhos/cm)	700

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1040
Total Alkalinity (mg of CaCO3/1)	410
Total Acidity (mg of CaCO3/1)	NA
Total Dissolved Solids (mg/l)	675
Sodium Adsorption Ratio	0.54
Total Hardness (mg of CaCO3/1)	551
Ionic Strength	1.84E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	3.58E-04	3.55E-04	
Calcium (Ca)	125	6.24E+00	3.12E-03
Magnesium (Mg)	58	4.77E+00	2.39E-03
Sodium (Na)	29	1.26E+00	1.26E-03
Potassium (K)	9	2.30E-01	2.30E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.016	2.85E-04	1.42E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	221	1.25E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	500	8.19E+00	8.19E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	45	1.27E+00	1.27E-03
Fluoride (F)	0.58	3.05E-02	3.05E-05
Nitrate + Nitrite (NOX)	20.74	3.84E-01	3.84E-04
Sulfate (SO4)	84	1.75E+00	8.74E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	650	1.16E+01	

Dissolved Solid Ratio	1.29
Cation-Anion Balance	3.65%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW19
Laboratory Number:	77465
Date Sampled:	2-20-85

Field Measurements	
Temperature(C)	11
pH (standard units)	7.2
Eh (millivolts)	169
Conductivity (micromhos/cm)	900

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	1300
Total Alkalinity (mg of CaCO3/l)	331
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	942
Sodium Adsorption Ratio	0.72
Total Hardness (mg of CaCO3/l)	619
Ionic Strength	2.35E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		6.36E-05	6.31E-05	
Calcium (Ca)		121	6.04E+00	3.02E-03
Magnesium (Mg)		77	6.33E+00	3.17E-03
Sodium (Na)		41	1.78E+00	1.78E-03
Potassium (K)		6	1.53E-01	1.53E-04
Arsenic (As)		0.006		8.01E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		245	1.43E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	403	6.61E+00	6.61E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	69	1.95E+00	1.95E-03
Fluoride (F)	1.37	7.21E-02	7.21E-05
Nitrate + Nitrite (NOX)	29.72	5.50E-01	5.50E-04
Sulfate (SO4)	266	5.54E+00	2.77E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	770	1.47E+01	

Dissolved Solid Ratio	1.08
Cation-Anion Balance	1.40%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW20
Laboratory Number:	77466
Date Sampled:	2-24-85

Field Measurements	
Temperature(C)	13
pH (standard units)	6.51
Eh (millivolts)	129
Conductivity (micromhos/cm)	625

Laboratory Measurements	
pH (standard units)	7.6
Conductivity (micromhos/cm)	1190
Total Alkalinity (mg of CaCO3/l)	269
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	868
Sodium Adsorption Ratio	0.88
Total Hardness (mg of CaCO3/l)	513
Ionic Strength	2.04E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.12E-04	3.09E-04	
Calcium (Ca)		105	5.24E+00	2.62E-03
Magnesium (Mg)		61	5.02E+00	2.51E-03
Sodium (Na)		46	2.00E+00	2.00E-03
Potassium (K)		24	6.14E-01	6.14E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)		0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)		0.006		7.60E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.06	1.84E-03	9.18E-07
Ammonium (NH4)				
Total		236	1.29E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	328	5.37E+00	5.37E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	63	1.78E+00	1.78E-03
Fluoride (F)	2.68	1.41E-01	1.41E-04
Nitrate + Nitrite (NOX)	6.73	1.25E-01	1.25E-04
Sulfate (SO4)	244	5.08E+00	2.54E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	644	1.25E+01	

Dissolved Solid Ratio	1.01
Cation-Anion Balance	1.50%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW21
Laboratory Number:	77467
Date Sampled:	2-25-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.3
Eh (millivolts)	1
Conductivity (micromhos/cm)	1110

Laboratory Measurements	
pH (standard units)	7.0
Conductivity (micromhos/cm)	1930
Total Alkalinity (mg of CaCO3/l)	1090
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1220
Sodium Adsorption Ratio	0.42
Total Hardness (mg of CaCO3/l)	1090
Ionic Strength	3.47E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	5.05E-04	5.01E-04	
Calcium (Ca)	51	2.54E+00	1.27E-03
Magnesium (Mg)	234	1.92E+01	9.63E-03
Sodium (Na)	32	1.39E+00	1.39E-03
Potassium (K)	16	4.09E-01	4.09E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	4.98	2.23E-01	8.92E-05
Lead (Pb)	0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.04	1.22E-03	6.12E-07
Ammonium (NH4)			
Total	338	2.38E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	1329	2.18E+01	2.18E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	20	5.64E-01	5.64E-04
Fluoride (F)	0.26	1.37E-02	1.37E-05
Nitrate + Nitrite (NOX)	0.27	5.00E-03	5.00E-06
Sulfate (SO4)	28	5.83E-01	2.91E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1377	2.29E+01	

Dissolved Solid Ratio	1.41
Cation-Anion Balance	1.87%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW22
Laboratory Number:	77265
Date Sampled:	2-18-85

Field Measurements	
Temperature(C)	14
pH (standard units)	8.09
Eh (millivolts)	-49
Conductivity (micromhos/cm)	1800

Laboratory Measurements	
pH (standard units)	8.0
Conductivity (micromhos/cm)	2840
Total Alkalinity (mg of CaCO3/l)	240
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	2120
Sodium Adsorption Ratio	2.13
Total Hardness (mg of CaCO3/l)	1139
Ionic Strength	5.29E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		8.19E-06	8.13E-06	
Calcium (Ca)		250	1.25E+01	6.24E-03
Magnesium (Mg)		125	1.03E+01	5.14E-03
Sodium (Na)		165	7.18E+00	7.18E-03
Potassium (K)		84	2.15E+00	2.15E-03
Arsenic (As)		0.007		9.34E-08
Cadmium (Cd)		0.018	3.20E-04	1.60E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.40	1.46E-02	7.28E-06
Selenium (Se)		0.016		2.03E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.07		1.37E-06
Zinc (Zn)		0.04	1.22E-03	6.12E-07
Ammonium (NH4)				
Total		625	3.21E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	293	4.79E+00	4.79E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	232	6.54E+00	6.54E-03
Fluoride (F)	12.30	6.47E-01	6.47E-04
Nitrate + Nitrite (NOX)	48.57	8.99E-01	8.99E-04
Sulfate (SO4)	912	1.90E+01	9.49E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1497	3.19E+01	

Dissolved Solid Ratio	1.00
Cation-Anion Balance	0.35%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW23
Laboratory Number:	77266
Date Sampled:	2-18-85

Field Measurements	
Temperature(C)	12
pH (standard units)	6.5
Eh (millivolts)	-4
Conductivity (micromhos/cm)	1210

Laboratory Measurements	
pH (standard units)	6.8
Conductivity (micromhos/cm)	2000
Total Alkalinity (mg of CaCO3/l)	618
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1430
Sodium Adsorption Ratio	0.54
Total Hardness (mg of CaCO3/l)	1104
Ionic Strength	3.99E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.19E-04	3.16E-04	
Calcium (Ca)		180	8.98E+00	4.49E-03
Magnesium (Mg)		159	1.31E+01	6.54E-03
Sodium (Na)		41	1.78E+00	1.78E-03
Potassium (K)		20	5.12E-01	5.12E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)		0.013	2.31E-04	1.16E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		5.28	2.36E-01	9.45E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.19	6.92E-03	3.46E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.07	2.14E-03	1.07E-06
Ammonium (NH4)				
Total		406	2.46E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		753	1.23E+01	1.23E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		83	2.34E+00	2.34E-03
Fluoride (F)		1.47	7.74E-02	7.74E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		431	8.97E+00	4.49E-03
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1269	2.37E+01	

Dissolved Solid Ratio	1.17
Cation-Anion Balance	1.78%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW24
Laboratory Number:	77267
Date Sampled:	2-18-85

Field Measurements	
Temperature(C)	12
pH (standard units)	11.24
Eh (millivolts)	-76
Conductivity (micromhos/cm)	2020

Laboratory Measurements	
pH (standard units)	11.3
Conductivity (micromhos/cm)	2710
Total Alkalinity (mg of CaCO3/l)	275
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1710
Sodium Adsorption Ratio	2.69
Total Hardness (mg of CaCO3/l)	877
Ionic Strength	ERR

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.80E-09	5.75E-09	
Calcium (Ca)		348	1.74E+01	8.68E-03
Magnesium (Mg)		2	1.64E-01	8.23E-05
Sodium (Na)		183	7.96E+00	7.96E-03
Potassium (K)		97	2.48E+00	2.48E-03
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)		0.007	1.25E-04	6.23E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		0.06	2.69E-03	1.07E-06
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)		0.016		2.03E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.03	9.18E-04	4.59E-07
Ammonium (NH4)				
Total		630	2.80E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	ERR	ERR	ERR
Carbonate (CO3)	119	3.97E+00	1.98E-03
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	26	1.53E+00	1.53E-03
Chloride (Cl)	227	6.40E+00	6.40E-03
Fluoride (F)	4.6	2.42E-01	2.42E-04
Nitrate + Nitrite (NOX)	35.74	6.62E-01	6.62E-04
Sulfate (SO4)	641	1.33E+01	6.67E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1053	2.61E+01	

Dissolved Solid Ratio	0.98
Cation-Anion Balance	3.38%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW25
Laboratory Number:	77468
Date Sampled:	3-02-85

Field Measurements	
Temperature(C)	22
pH (standard units)	9.4
Eh (millivolts)	33
Conductivity (micromhos/cm)	1180

Laboratory Measurements	
pH (standard units)	9.0
Conductivity (micromhos/cm)	1710
Total Alkalinity (mg of CaCO3/l)	605
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1300
Sodium Adsorption Ratio	0.5
Total Hardness (mg of CaCO3/l)	1084
Ionic Strength	3.63E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.01E-07	3.98E-07	
Calcium (Ca)		55	2.74E+00	1.37E-03
Magnesium (Mg)		230	1.89E+01	9.46E-03
Sodium (Na)		38	1.65E+00	1.65E-03
Potassium (K)		6	1.53E-01	1.53E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		329	2.35E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	563	9.23E+00	9.23E-03
Carbonate (CO3)	86	2.87E+00	1.43E-03
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	115	3.24E+00	3.24E-03
Fluoride (F)	0.32	1.68E-02	1.68E-05
Nitrate + Nitrite (NOX)	0.19	3.57E-03	3.57E-06
Sulfate (SO4)	360	7.50E+00	3.75E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1125	2.29E+01	

Dissolved Solid Ratio	1.12
Cation-Anion Balance	1.33%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW26
Laboratory Number:	77469
Date Sampled:	3-01-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.86
Eh (millivolts)	79
Conductivity (micromhos/cm)	1390

Laboratory Measurements	
pH (standard units)	7.6
Conductivity (micromhos/cm)	2040
Total Alkalinity (mg of CaCO3/l)	339
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1560
Sodium Adsorption Ratio	1.16
Total Hardness (mg of CaCO3/l)	988
Ionic Strength	3.92E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.39E-04	1.38E-04	
Calcium (Ca)	117	5.84E+00	2.92E-03
Magnesium (Mg)	169	1.39E+01	6.95E-03
Sodium (Na)	84	3.65E+00	3.65E-03
Potassium (K)	16	4.09E-01	4.09E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	1.15	4.19E-02	2.09E-05
Selenium (Se)	0.006		7.60E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.07	2.14E-03	1.07E-06
Ammonium (NH4)			
Total	387	2.38E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	413	6.77E+00	6.77E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	179	5.05E+00	5.05E-03
Fluoride (F)	0.76	4.00E-02	4.00E-05
Nitrate + Nitrite (NOX)	27.56	5.10E-01	5.10E-04
Sulfate (SO4)	536	1.12E+01	5.58E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1157	2.35E+01	

Dissolved Solid Ratio	0.99
Cation-Anion Balance	0.67%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW27
Laboratory Number:	77470
Date Sampled:	2-24-85

Field Measurements

Temperature(C)	14
pH (standard units)	6.35
Eh (millivolts)	121
Conductivity (micromhos/cm)	990

Laboratory Measurements

pH (standard units)	7.5
Conductivity (micromhos/cm)	1710
Total Alkalinity (mg of CaCO3/l)	254
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1310
Sodium Adsorption Ratio	1.96
Total Hardness (mg of CaCO3/l)	687
Ionic Strength	3.17E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	4.50E-04	4.47E-04	
Calcium (Ca)	168	8.38E+00	4.19E-03
Magnesium (Mg)	65	5.35E+00	2.67E-03
Sodium (Na)	118	5.13E+00	5.13E-03
Potassium (K)	17	4.35E-01	4.35E-04
Arsenic (As)	0.006		8.01E-08
Cadmium (Cd)	0.023	4.09E-04	2.05E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.15	5.46E-03	2.73E-06
Selenium (Se)	0.028		3.55E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.09	2.75E-03	1.38E-06
Ammonium (NH4)			
Total	368	1.93E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	310	5.07E+00	5.07E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	65	1.83E+00	1.83E-03
Fluoride (F)	2.68	1.41E-01	1.41E-04
Nitrate + Nitrite (NOX)	46.26	8.57E-01	8.57E-04
Sulfate (SO4)	538	1.12E+01	5.60E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	962	1.91E+01	

Dissolved Solid Ratio	1.02
Cation-Anion Balance	0.53%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW28
Laboratory Number:	77471
Date Sampled:	2-23-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.05
Eh (millivolts)	158
Conductivity (micromhos/cm)	825

Laboratory Measurements	
pH (standard units)	7.1
Conductivity (micromhos/cm)	1460
Total Alkalinity (mg of CaCO3/l)	736
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1080
Sodium Adsorption Ratio	0.29
Total Hardness (mg of CaCO3/l)	821
Ionic Strength	2.64E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	8.98E-04	8.91E-04	
Calcium (Ca)	182	9.08E+00	4.54E-03
Magnesium (Mg)	89	7.32E+00	3.66E-03
Sodium (Na)	19	8.26E-01	8.26E-04
Potassium (K)	6	1.53E-01	1.53E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.013	2.31E-04	1.16E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.07	2.14E-03	1.07E-06
Ammonium (NH4)			
Total	296	1.74E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	897	1.47E+01	1.47E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	27	7.62E-01	7.62E-04
Fluoride (F)	0.22	1.16E-02	1.16E-05
Nitrate + Nitrite (NOX)	14.19	2.63E-01	2.63E-04
Sulfate (SO4)	78	1.62E+00	8.12E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1017	1.74E+01	

Dissolved Solid Ratio	1.22
Cation-Anion Balance	0.07%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW29
Laboratory Number:	77268
Date Sampled:	2-20-85

Field Measurements	
Temperature(C)	12
pH (standard units)	6.52
Eh (millivolts)	206
Conductivity (micromhos/cm)	600

Laboratory Measurements	
pH (standard units)	7.0
Conductivity (micromhos/cm)	1190
Total Alkalinity (mg of CaCO3/l)	547
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	700
Sodium Adsorption Ratio	0.39
Total Hardness (mg of CaCO3/l)	671
Ionic Strength	2.19E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	3.04E-04	3.02E-04	
Calcium (Ca)	150	7.49E+00	3.74E-03
Magnesium (Mg)	72	5.92E+00	2.96E-03
Sodium (Na)	23	1.00E+00	1.00E-03
Potassium (K)	4	1.02E-01	1.02E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	249	1.45E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	667	1.09E+01	1.09E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	17	4.80E-01	4.80E-04
Fluoride (F)	0.38	2.00E-02	2.00E-05
Nitrate + Nitrite (NOX)	19.97	3.70E-01	3.70E-04
Sulfate (SO4)	96	2.00E+00	9.99E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	800	1.38E+01	

Dissolved Solid Ratio	1.50
Cation-Anion Balance	2.54%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW30
Laboratory Number:	77269
Date Sampled:	2-21-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.65
Eh (millivolts)	122
Conductivity (micromhos/cm)	1425

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	2090
Total Alkalinity (mg of CaCO3/l)	397
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1410
Sodium Adsorption Ratio	2.47
Total Hardness (mg of CaCO3/l)	739
Ionic Strength	3.32E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	2.26E-04	2.24E-04	
Calcium (Ca)	149	7.44E+00	3.72E-03
Magnesium (Mg)	89	7.32E+00	3.66E-03
Sodium (Na)	154	6.70E+00	6.70E-03
Potassium (K)	33	8.44E-01	8.44E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	0.007		8.87E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	425	2.23E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	484	7.93E+00	7.93E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	189	5.33E+00	5.33E-03
Fluoride (F)	3.61	1.90E-01	1.90E-04
Nitrate + Nitrite (NOX)	37.86	7.01E-01	7.01E-04
Sulfate (SO4)	367	7.64E+00	3.82E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1081	2.18E+01	

Dissolved Solid Ratio	1.07
Cation-Anion Balance	1.15%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW31
Laboratory Number:	77270
Date Sampled:	2-20-85

Field Measurements	
Temperature(C)	14
pH (standard units)	7.25
Eh (millivolts)	145
Conductivity (micromhos/cm)	575

Laboratory Measurements	
pH (standard units)	7.7
Conductivity (micromhos/cm)	824
Total Alkalinity (mg of CaCO3/1)	355
Total Acidity (mg of CaCO3/1)	NA
Total Dissolved Solids (mg/1)	460
Sodium Adsorption Ratio	0.45
Total Hardness (mg of CaCO3/1)	416
Ionic Strength	1.37E-02

Cations	mg/1	meq/1	moles/1
Hydrogen (H)	5.67E-05	5.62E-05	
Calcium (Ca)	109	5.44E+00	2.72E-03
Magnesium (Mg)	35	2.88E+00	1.44E-03
Sodium (Na)	21	9.13E-01	9.13E-04
Potassium (K)	3	7.67E-02	7.67E-05
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.16		3.14E-06
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	168	9.31E+00	

Anions	mg/1	meq/1	moles/1
Bicarbonate(HCO3)	433	7.09E+00	7.09E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	18	5.08E-01	5.08E-04
Fluoride (F)	0.34	1.79E-02	1.79E-05
Nitrate + Nitrite (NOX)	18.47	3.42E-01	3.42E-04
Sulfate (SO4)	45	9.37E-01	4.68E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	515	8.90E+00	

Dissolved Solid Ratio	1.48
Cation-Anion Balance	2.29%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW32
Laboratory Number:	77472
Date Sampled:	2-28-85

Field Measurements	
Temperature(C)	17
pH (standard units)	8.77
Eh (millivolts)	106
Conductivity (micromhos/cm)	400

Laboratory Measurements	
pH (standard units)	8.7
Conductivity (micromhos/cm)	464
Total Alkalinity (mg of CaCO3/l)	134
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	294
Sodium Adsorption Ratio	0.9
Total Hardness (mg of CaCO3/l)	170
Ionic Strength	6.96E-03

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.71E-06	1.70E-06	
Calcium (Ca)		17	8.48E-01	4.24E-04
Magnesium (Mg)		31	2.55E+00	1.28E-03
Sodium (Na)		27	1.17E+00	1.17E-03
Potassium (K)		10	2.56E-01	2.56E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)		0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.31		6.09E-06
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		85	4.83E+00	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	163	2.68E+00	2.68E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	22	6.21E-01	6.21E-04
Fluoride (F)	0.22	1.16E-02	1.16E-05
Nitrate + Nitrite (NOX)	27.41	5.07E-01	5.07E-04
Sulfate (SO4)	45	9.37E-01	4.68E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	258	4.75E+00	

Dissolved Solid Ratio	1.17
Cation-Anion Balance	0.83%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW33
Laboratory Number:	77473
Date Sampled:	2-28-85

Field Measurements	
Temperature(C)	17
pH (standard units)	8.76
Eh (millivolts)	141
Conductivity (micromhos/cm)	700

Laboratory Measurements	
pH (standard units)	7.6
Conductivity (micromhos/cm)	894
Total Alkalinity (mg of CaCO3/l)	402
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	562
Sodium Adsorption Ratio	0.32
Total Hardness (mg of CaCO3/l)	479
Ionic Strength	1.53E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.75E-06	1.74E-06	
Calcium (Ca)	126	6.29E+00	3.14E-03
Magnesium (Mg)	40	3.29E+00	1.65E-03
Sodium (Na)	16	6.96E-01	6.96E-04
Potassium (K)	2	5.12E-02	5.12E-05
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.3		5.89E-06
Zinc (Zn)	0.03	9.18E-04	4.59E-07
Ammonium (NH4)			
Total	184	1.03E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	490	8.03E+00	8.03E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	23	6.49E-01	6.49E-04
Fluoride (F)	0.24	1.26E-02	1.26E-05
Nitrate + Nitrite (NOX)	10.02	1.86E-01	1.86E-04
Sulfate (SO4)	43	8.95E-01	4.48E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	566	9.77E+00	

Dissolved Solid Ratio	1.34
Cation-Anion Balance	2.77%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW34
Laboratory Number:	77475
Date Sampled:	2-26-85

Field Measurements	
Temperature(C)	10
pH (standard units)	6.94
Eh (millivolts)	39
Conductivity (micromhos/cm)	600

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	1190
Total Alkalinity (mg of CaCO3/l)	402
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	852
Sodium Adsorption Ratio	0.3
Total Hardness (mg of CaCO3/l)	698
Ionic Strength	2.38E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.16E-04	1.15E-04	
Calcium (Ca)	123	6.14E+00	3.07E-03
Magnesium (Mg)	95	7.81E+00	3.91E-03
Sodium (Na)	18	7.83E-01	7.83E-04
Potassium (K)	6	1.53E-01	1.53E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	0.16	7.16E-03	2.86E-06
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.27	9.83E-03	4.91E-06
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	243	1.49E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	490	8.03E+00	8.03E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	64	1.81E+00	1.81E-03
Fluoride (F)	0.44	2.32E-02	2.32E-05
Nitrate + Nitrite (NOX)	2.51	4.64E-02	4.64E-05
Sulfate (SO4)	213	4.43E+00	2.22E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	770	1.43E+01	

Dissolved Solid Ratio	1.19
Cation-Anion Balance	1.93%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW35
Laboratory Number:	77476
Date Sampled:	2-26-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.59
Eh (millivolts)	22
Conductivity (micromhos/cm)	1430

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1990
Total Alkalinity (mg of CaCO3/l)	1200
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1320
Sodium Adsorption Ratio	0.44
Total Hardness (mg of CaCO3/l)	1299
Ionic Strength	4.14E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		2.59E-04	2.57E-04	
Calcium (Ca)		100	4.99E+00	2.50E-03
Magnesium (Mg)		255	2.10E+01	1.05E-02
Sodium (Na)		36	1.57E+00	1.57E-03
Potassium (K)		16	4.09E-01	4.09E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		3.51	1.57E-01	6.28E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.21	7.64E-03	3.82E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.06	1.84E-03	9.18E-07
Ammonium (NH4)				
Total		411	2.81E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1463	2.40E+01	2.40E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		32	9.03E-01	9.03E-04
Fluoride (F)		0.37	1.95E-02	1.95E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		88	1.83E+00	9.16E-04
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1583	2.67E+01	

Dissolved Solid Ratio	1.51
Cation-Anion Balance	2.51%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW36
Laboratory Number:	77477
Date Sampled:	2-26-85

Field Measurements	
Temperature(C)	13
pH (standard units)	6.79
Eh (millivolts)	57
Conductivity (micromhos/cm)	990

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1500
Total Alkalinity (mg of CaCO3/l)	288
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1070
Sodium Adsorption Ratio	1.03
Total Hardness (mg of CaCO3/l)	706
Ionic Strength	2.88E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.63E-04	1.62E-04	
Calcium (Ca)	131	6.54E+00	3.27E-03
Magnesium (Mg)	92	7.57E+00	3.78E-03
Sodium (Na)	63	2.74E+00	2.74E-03
Potassium (K)	28	7.16E-01	7.16E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.053	9.43E-04	4.72E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.08	2.91E-03	1.46E-06
Selenium (Se)	0.078		9.88E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.72	2.20E-02	1.10E-05
Ammonium (NH4)			
Total	315	1.76E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	351	5.75E+00	5.75E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	101	2.85E+00	2.85E-03
Fluoride (F)	11.9	6.26E-01	6.26E-04
Nitrate + Nitrite (NOX)	34.93	6.47E-01	6.47E-04
Sulfate (SO4)	385	8.02E+00	4.01E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	884	1.79E+01	

Dissolved Solid Ratio	1.12
Cation-Anion Balance	0.85%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW37
Laboratory Number:	77271
Date Sampled:	2-19-85

Field Measurements	
Temperature(C)	17
pH (standard units)	7.15
Eh (millivolts)	83
Conductivity (micromhos/cm)	1910

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	2660
Total Alkalinity (mg of CaCO3/l)	432
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1860
Sodium Adsorption Ratio	2.21
Total Hardness (mg of CaCO3/l)	992
Ionic Strength	4.58E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	7.14E-05	7.08E-05	
Calcium (Ca)	244	1.22E+01	6.09E-03
Magnesium (Mg)	93	7.65E+00	3.83E-03
Sodium (Na)	160	6.96E+00	6.96E-03
Potassium (K)	103	2.63E+00	2.63E-03
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	1.210	2.15E-02	1.08E-05
Chromium (Cr)	0.05	1.92E-03	9.62E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	2.50	9.10E-02	4.55E-05
Selenium (Se)	0.066		8.36E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.15		2.94E-06
Zinc (Zn)	4.3	1.32E-01	6.58E-05
Ammonium (NH4)			
Total	608	2.97E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	527	8.63E+00	8.63E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	214	6.04E+00	6.04E-03
Fluoride (F)	31.3	1.65E+00	1.65E-03
Nitrate + Nitrite (NOX)	43.95	8.14E-01	8.14E-04
Sulfate (SO4)	600	1.25E+01	6.25E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1416	2.96E+01	

Dissolved Solid Ratio	1.09
Cation-Anion Balance	0.08%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW38
Laboratory Number:	77478
Date Sampled:	3-01-85

Field Measurements	
Temperature(C)	17
pH (standard units)	6.3
Eh (millivolts)	135
Conductivity (micromhos/cm)	700

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	916
Total Alkalinity (mg of CaCO3/l)	406
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	626
Sodium Adsorption Ratio	0.46
Total Hardness (mg of CaCO3/l)	516
Ionic Strength	1.69E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.05E-04	5.01E-04	
Calcium (Ca)		126	6.29E+00	3.14E-03
Magnesium (Mg)		49	4.03E+00	2.02E-03
Sodium (Na)		24	1.04E+00	1.04E-03
Potassium (K)		2	5.12E-02	5.12E-05
Arsenic (As)		0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)		0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		201	1.14E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	495	8.11E+00	8.11E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	30	8.46E-01	8.46E-04
Fluoride (F)	0.31	1.63E-02	1.63E-05
Nitrate + Nitrite (NOX)	44.72	8.28E-01	8.28E-04
Sulfate (SO4)	56	1.17E+00	5.83E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	626	1.10E+01	

Dissolved Solid Ratio	1.32
Cation-Anion Balance	2.01%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW39
Laboratory Number:	77480
Date Sampled:	2-28-85

Field Measurements	
Temperature(C)	19
pH (standard units)	8.39
Eh (millivolts)	5
Conductivity (micromhos/cm)	1050

Laboratory Measurements	
pH (standard units)	8.5
Conductivity (micromhos/cm)	1240
Total Alkalinity (mg of CaCO3/l)	176
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	874
Sodium Adsorption Ratio	1.38
Total Hardness (mg of CaCO3/l)	499
Ionic Strength	2.17E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	4.11E-06	4.07E-06	
Calcium (Ca)	73	3.64E+00	1.82E-03
Magnesium (Mg)	77	6.33E+00	3.17E-03
Sodium (Na)	71	3.09E+00	3.09E-03
Potassium (K)	32	8.18E-01	8.18E-04
Arsenic (As)	0.008		1.07E-07
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	0.076		9.63E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	253	1.39E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	215	3.52E+00	3.52E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	87	2.45E+00	2.45E-03
Fluoride (F)	6.88	3.62E-01	3.62E-04
Nitrate + Nitrite (NOX)	28.87	5.35E-01	5.35E-04
Sulfate (SO4)	306	6.37E+00	3.19E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	643	1.32E+01	

Dissolved Solid Ratio	1.03
Cation-Anion Balance	2.39%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW40
Laboratory Number:	77481
Date Sampled:	2-23-85

Field Measurements	
Temperature(C)	19
pH (standard units)	6
Eh (millivolts)	-40
Conductivity (micromhos/cm)	3650

Laboratory Measurements	
pH (standard units)	6.9
Conductivity (micromhos/cm)	6180
Total Alkalinity (mg of CaCO3/l)	94
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	4900
Sodium Adsorption Ratio	5.7
Total Hardness (mg of CaCO3/l)	1919
Ionic Strength	1.12E-01

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.01E-03	1.00E-03	
Calcium (Ca)		451	2.25E+01	1.13E-02
Magnesium (Mg)		193	1.59E+01	7.94E-03
Sodium (Na)		574	2.50E+01	2.50E-02
Potassium (K)		439	1.12E+01	1.12E-02
Arsenic (As)		0.007		9.34E-08
Cadmium (Cd)		70.400	1.25E+00	6.26E-04
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)		0.04	1.22E-03	6.10E-07
Iron (Fe)	<	0.02	8.95E-04	3.58E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		11.00	4.00E-01	2.00E-04
Selenium (Se)		0.055		6.97E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.16		3.14E-06
Zinc (Zn)		169	5.17E+00	2.59E-03
Ammonium (NH4)				
Total		1908	8.14E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	115	1.88E+00	1.88E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	1180	3.33E+01	3.33E-02
Fluoride (F)	11.9	6.26E-01	6.26E-04
Nitrate + Nitrite (NOX)	75.17	1.39E+00	1.39E-03
Sulfate (SO4)	1770	3.69E+01	1.84E-02
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	3152	7.40E+01	

Dissolved Solid Ratio	1.03
Cation-Anion Balance	4.74%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	HOOPER
Laboratory Number:	77254
Date Sampled:	2-15-85

Field Measurements	
Temperature(C)	16
pH (standard units)	5.85
Eh (millivolts)	39
Conductivity (micromhos/cm)	1000

Laboratory Measurements	
pH (standard units)	6.4
Conductivity (micromhos/cm)	1440
Total Alkalinity (mg of CaCO3/l)	787
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	980
Sodium Adsorption Ratio	0.36
Total Hardness (mg of CaCO3/l)	773
Ionic Strength	2.55E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.42E-03	1.41E-03	
Calcium (Ca)		115	5.74E+00	2.87E-03
Magnesium (Mg)		118	9.70E+00	4.85E-03
Sodium (Na)		23	1.00E+00	1.00E-03
Potassium (K)		14	3.58E-01	3.58E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)		5.27	2.36E-01	9.44E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.17	6.19E-03	3.09E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)				
Total		276	1.70E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		959	1.57E+01	1.57E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)		ERR	ERR	ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		8	2.26E-01	2.26E-04
Fluoride (F)		0.58	3.05E-02	3.05E-05
Nitrate + Nitrite (NOX)	<	0.19	3.57E-03	3.57E-06
Sulfate (SO4)		54	1.12E+00	5.62E-04
Dissolved Silica (H4SiO4)				
(H3SiO4)				
(H2SiO4)				
(HSiO4)				
Total		1022	1.71E+01	

Dissolved Solid Ratio	1.32
Cation-Anion Balance	0.17%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	DOCK
Laboratory Number:	77258
Date Sampled:	2-18-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.02
Eh (millivolts)	52
Conductivity (micromhos/cm)	725

Laboratory Measurements	
pH (standard units)	6.3
Conductivity (micromhos/cm)	1470
Total Alkalinity (mg of CaCO3/l)	813
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	920
Sodium Adsorption Ratio	0.4
Total Hardness (mg of CaCO3/l)	816
Ionic Strength	2.70E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	9.63E-04	9.55E-04	
Calcium (Ca)	116	5.79E+00	2.89E-03
Magnesium (Mg)	128	1.05E+01	5.27E-03
Sodium (Na)	26	1.13E+00	1.13E-03
Potassium (K)	15	3.84E-01	3.84E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	7.20	3.22E-01	1.29E-04
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.16	5.82E-03	2.91E-06
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.01	3.06E-04	1.53E-07
Ammonium (NH4)			
Total	293	1.82E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	991	1.62E+01	1.62E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	12	3.39E-01	3.39E-04
Fluoride (F)	0.62	3.26E-02	3.26E-05
Nitrate + Nitrite (NOX)	< 0.19	3.57E-03	3.57E-06
Sulfate (SO4)	59	1.23E+00	6.14E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1063	1.78E+01	

Dissolved Solid Ratio	1.47
Cation-Anion Balance	0.88%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	SW SPRING
Laboratory Number:	77253
Date Sampled:	2-15-85

Field Measurements	
Temperature(C)	15
pH (standard units)	6.25
Eh (millivolts)	95
Conductivity (micromhos/cm)	1050

Laboratory Measurements	
pH (standard units)	6.8
Conductivity (micromhos/cm)	1630
Total Alkalinity (mg of CaCO3/l)	808
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1150
Sodium Adsorption Ratio	0.69
Total Hardness (mg of CaCO3/l)	869
Ionic Strength	2.96E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	5.67E-04	5.62E-04	
Calcium (Ca)	127	6.34E+00	3.17E-03
Magnesium (Mg)	134	1.10E+01	5.51E-03
Sodium (Na)	47	2.04E+00	2.04E-03
Potassium (K)	15	3.84E-01	3.84E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.009	1.60E-04	8.01E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.02	8.95E-04	3.58E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.17	6.19E-03	3.09E-06
Selenium (Se)	0.006		7.60E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.08	2.45E-03	1.22E-06
Ammonium (NH4)			
Total	323	1.98E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	985	1.61E+01	1.61E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	33	9.31E-01	9.31E-04
Fluoride (F)	1.60	8.42E-02	8.42E-05
Nitrate + Nitrite (NOX)	13.57	2.51E-01	2.51E-04
Sulfate (SO4)	113	2.35E+00	1.18E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	1146	1.98E+01	

Dissolved Solid Ratio	1.28
Cation-Anion Balance	0.09%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	MORMAN
Laboratory Number:	77256
Date Sampled:	2-18-85

Field Measurements

Temperature(C)	14
pH (standard units)	6.96
Eh (millivolts)	138
Conductivity (micromhos/cm)	1000

Laboratory Measurements

pH (standard units)	7.2
Conductivity (micromhos/cm)	1430
Total Alkalinity (mg of CaCO3/l)	310
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1050
Sodium Adsorption Ratio	1.18
Total Hardness (mg of CaCO3/l)	632
Ionic Strength	2.52E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.11E-04	1.10E-04	
Calcium (Ca)	123	6.14E+00	3.07E-03
Magnesium (Mg)	79	6.50E+00	3.25E-03
Sodium (Na)	68	2.96E+00	2.96E-03
Potassium (K)	22	5.63E-01	5.63E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.038	6.76E-04	3.38E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.009		1.14E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.30	9.18E-03	4.59E-06
Ammonium (NH4)			
Total	293	1.62E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	378	6.19E+00	6.19E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	78	2.20E+00	2.20E-03
Fluoride (F)	10.8	5.68E-01	5.68E-04
Nitrate + Nitrite (NOX)	24.63	4.56E-01	4.56E-04
Sulfate (SO4)	293	6.10E+00	3.05E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	784	1.55E+01	

Dissolved Solid Ratio	1.03
Cation-Anion Balance	2.06%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	CALF
Laboratory Number:	77257
Date Sampled:	2-18-85

Field Measurements	
Temperature(C)	12
pH (standard units)	7.03
Eh (millivolts)	116
Conductivity (micromhos/cm)	875

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	1410
Total Alkalinity (mg of CaCO3/l)	298
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1030
Sodium Adsorption Ratio	1.05
Total Hardness (mg of CaCO3/l)	637
Ionic Strength	2.52E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		9.41E-05	9.33E-05	
Calcium (Ca)		128	6.39E+00	3.19E-03
Magnesium (Mg)		77	6.33E+00	3.17E-03
Sodium (Na)		61	2.65E+00	2.65E-03
Potassium (K)		21	5.37E-01	5.37E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Copper (Cu)	<	0.02	6.10E-04	3.05E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.05		9.82E-07
Zinc (Zn)		0.08	2.45E-03	1.22E-06
Ammonium (NH4)				
Total		287	1.59E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	363	5.95E+00	5.95E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	64	1.81E+00	1.81E-03
Fluoride (F)	8.85	4.66E-01	4.66E-04
Nitrate + Nitrite (NOX)	24.86	4.60E-01	4.60E-04
Sulfate (SO4)	316	6.58E+00	3.29E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	777	1.53E+01	

Dissolved Solid Ratio	1.03
Cation-Anion Balance	2.10%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	EFFLUENT
Laboratory Number:	77260
Date Sampled:	2-19-85

Field Measurements	
Temperature(C)	15
pH (standard units)	7.9
Eh (millivolts)	79
Conductivity (micromhos/cm)	750

Laboratory Measurements	
pH (standard units)	8.1
Conductivity (micromhos/cm)	1220
Total Alkalinity (mg of CaCO3/l)	422
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	804
Sodium Adsorption Ratio	1.38
Total Hardness (mg of CaCO3/l)	558
Ionic Strength	2.12E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.27E-05	1.26E-05	
Calcium (Ca)	126	6.29E+00	3.14E-03
Magnesium (Mg)	59	4.85E+00	2.43E-03
Sodium (Na)	75	3.26E+00	3.26E-03
Potassium (K)	10	2.56E-01	2.56E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.030	5.34E-04	2.67E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.05	1.53E-03	7.65E-07
Ammonium (NH4)			
Total	270	1.47E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	514	8.43E+00	8.43E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	75	2.12E+00	2.12E-03
Fluoride (F)	1.02	5.37E-02	5.37E-05
Nitrate + Nitrite (NOX)	21.90	4.05E-01	4.05E-04
Sulfate (SO4)	133	2.77E+00	1.38E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	745	1.38E+01	

Dissolved Solid Ratio	1.26
Cation-Anion Balance	3.13%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	SWG
Laboratory Number:	77259
Date Sampled:	2-18-85

Field Measurements	
Temperature(C)	14
pH (standard units)	6.99
Eh (millivolts)	121
Conductivity (micromhos/cm)	775

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1300
Total Alkalinity (mg of CaCO3/l)	292
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	956
Sodium Adsorption Ratio	0.92
Total Hardness (mg of CaCO3/l)	608
Ionic Strength	2.37E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.03E-04	1.02E-04	
Calcium (Ca)	123	6.14E+00	3.07E-03
Magnesium (Mg)	73	6.00E+00	3.00E-03
Sodium (Na)	52	2.26E+00	2.26E-03
Potassium (K)	20	5.12E-01	5.12E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	0.06	1.83E-03	9.15E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)			
Total	268	1.49E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	356	5.83E+00	5.83E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	56	1.58E+00	1.58E-03
Fluoride (F)	7.52	3.96E-01	3.96E-04
Nitrate + Nitrite (NOX)	23.36	4.33E-01	4.33E-04
Sulfate (SO4)	291	6.06E+00	3.03E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	734	1.43E+01	

Dissolved Solid Ratio	1.05
Cation-Anion Balance	2.13%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	LEWIS
Laboratory Number:	77255
Date Sampled:	2-15-85

Field Measurements	
Temperature(C)	20
pH (standard units)	6.04
Eh (millivolts)	128
Conductivity (micromhos/cm)	700

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1150
Total Alkalinity (mg of CaCO3/l)	397
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	832
Sodium Adsorption Ratio	0.78
Total Hardness (mg of CaCO3/l)	552
Ionic Strength	1.97E-02

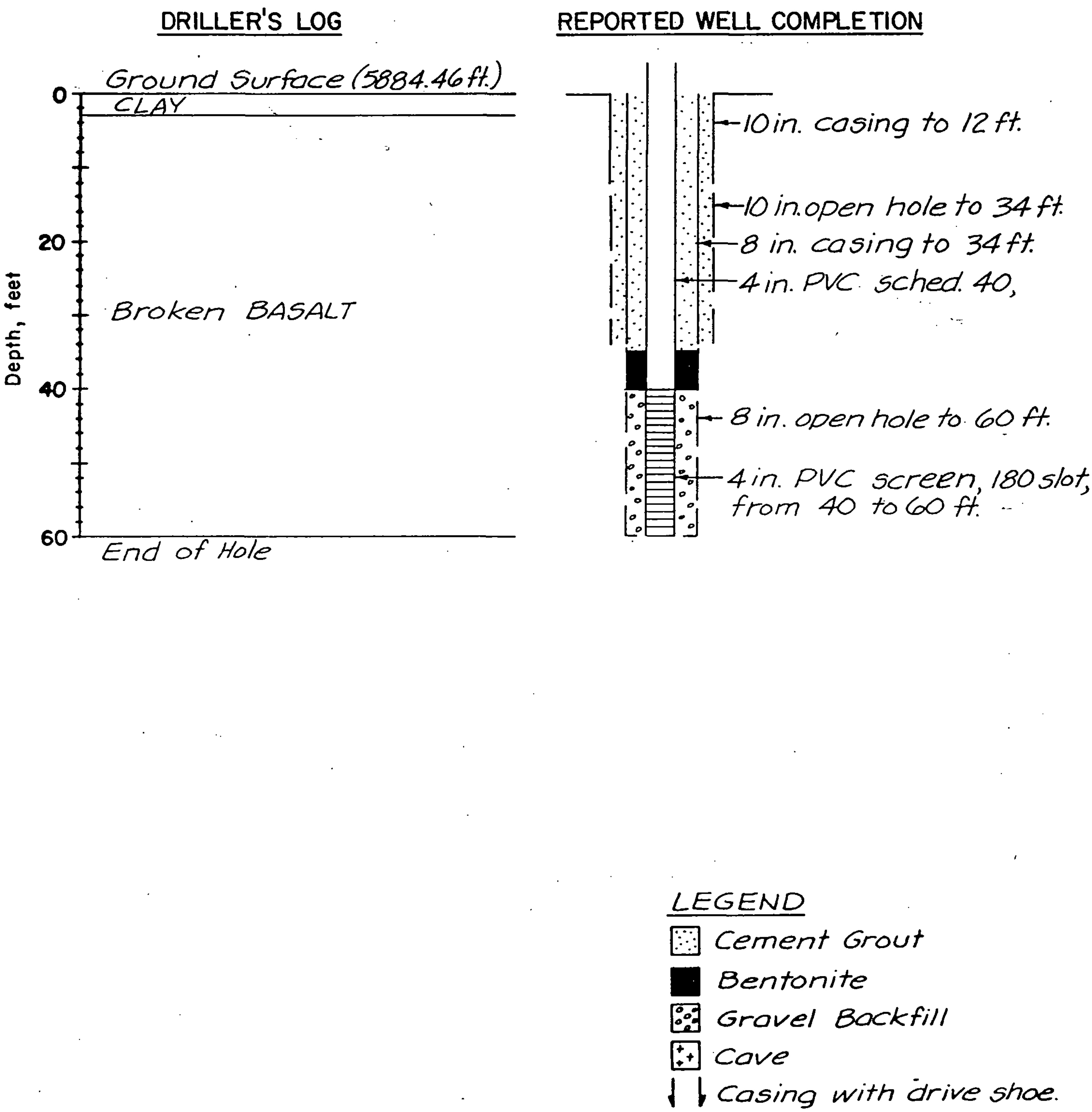
Cations	mg/l	meq/l	moles/l
Hydrogen (H)	9.19E-04	9.12E-04	
Calcium (Ca)	119	5.94E+00	2.97E-03
Magnesium (Mg)	62	5.10E+00	2.55E-03
Sodium (Na)	42	1.83E+00	1.83E-03
Potassium (K)	7	1.79E-01	1.79E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Copper (Cu)	< 0.02	6.10E-04	3.05E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.09	2.75E-03	1.38E-06
Ammonium (NH4)			
Total	230	1.31E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	484	7.93E+00	7.93E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO3)	ERR	ERR	ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	39	1.10E+00	1.10E-03
Fluoride (F)	0.51	2.68E-02	2.68E-05
Nitrate + Nitrite (NOX)	25.29	4.68E-01	4.68E-04
Sulfate (SO4)	139	2.89E+00	1.45E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
Total	688	1.24E+01	

Dissolved Solid Ratio	1.10
Cation-Anion Balance	2.48%

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 7

Figure A-7



Scale 1 in. to 20 ft

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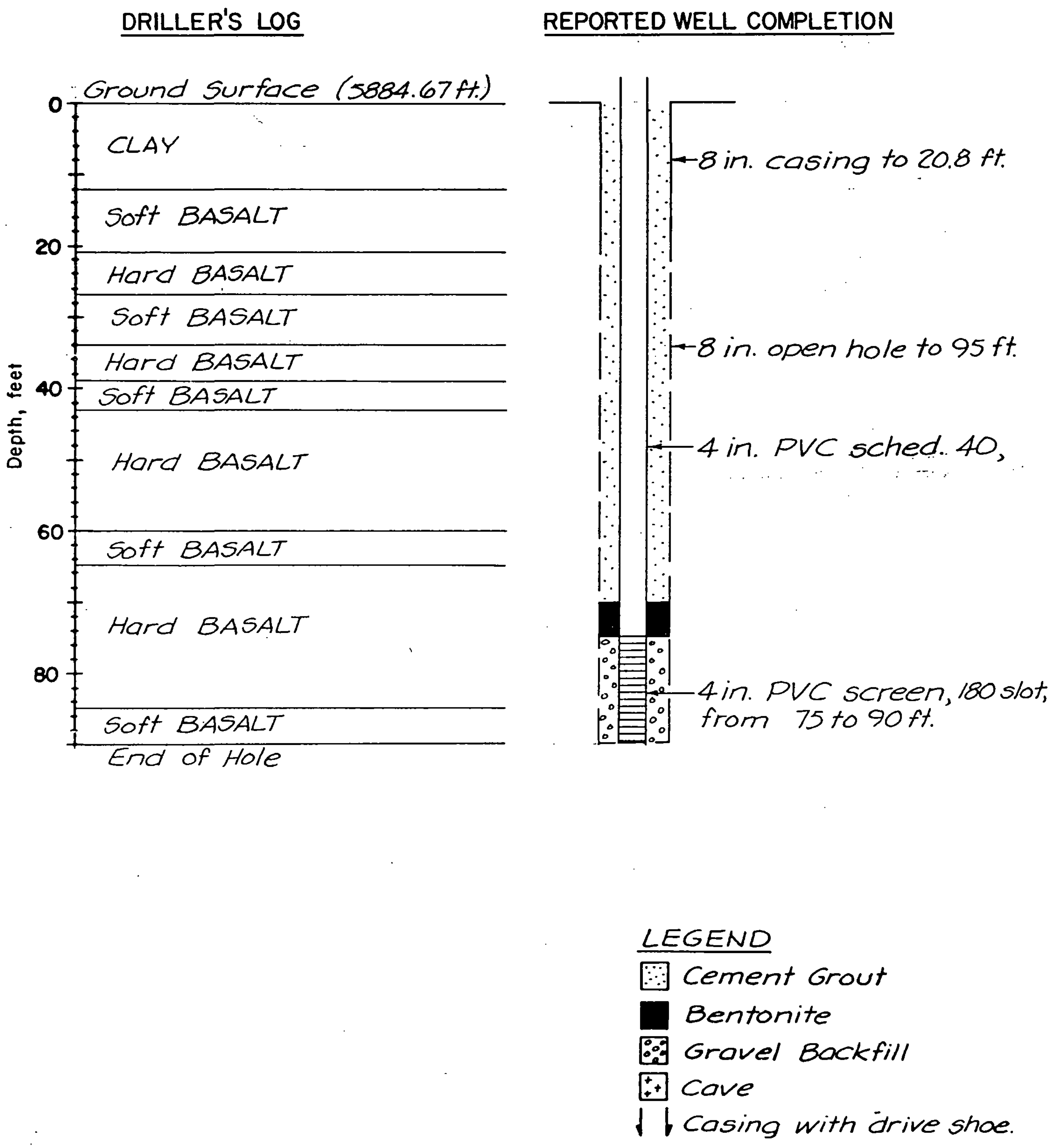
PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE ....

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 8

Figure A-8



Scale 1 in. to 20 ft

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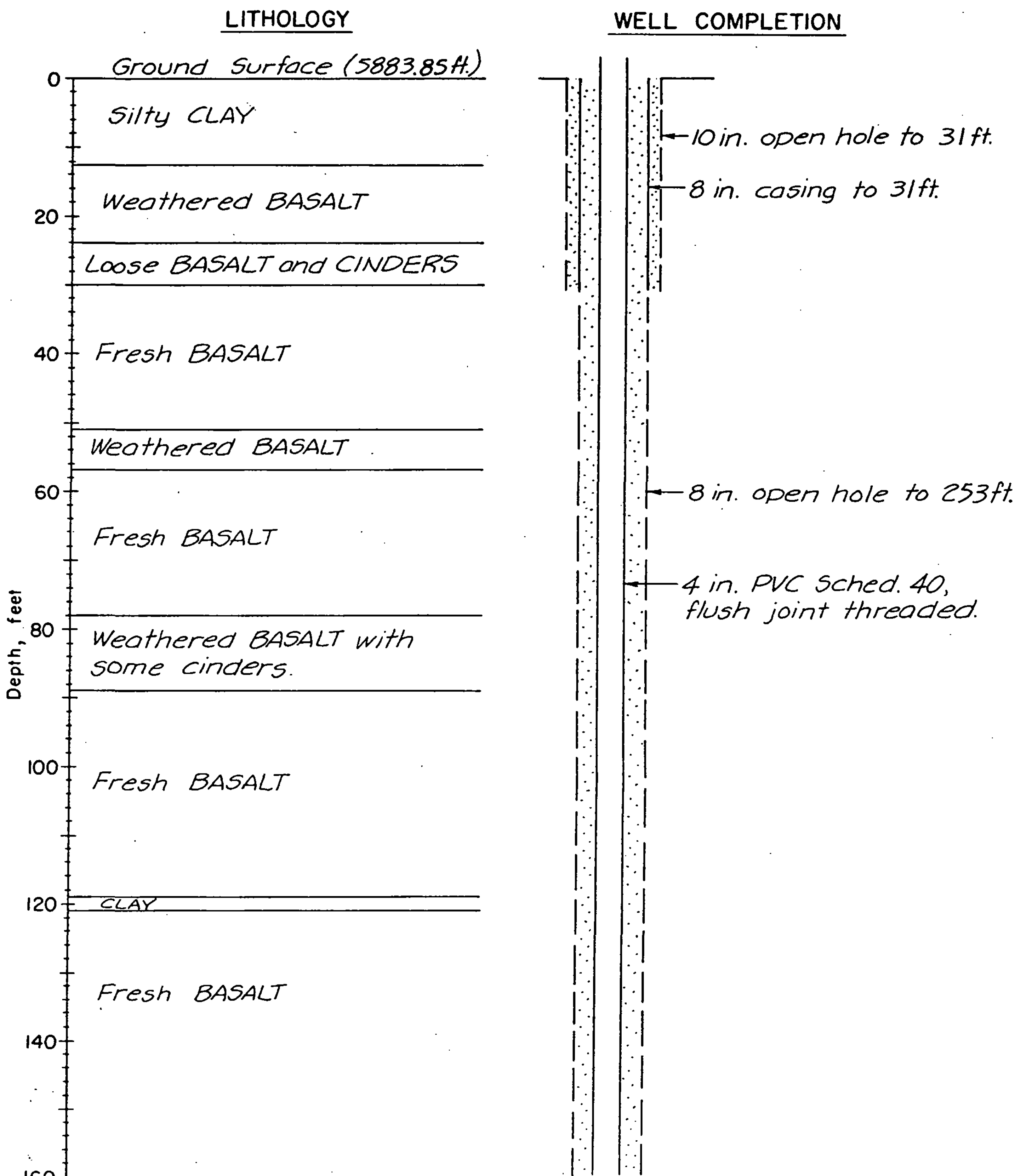
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 9

Figure A-9

Sheet 1 of 2



Cont'd. on sheet 2 of 2

Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE Dec. '84

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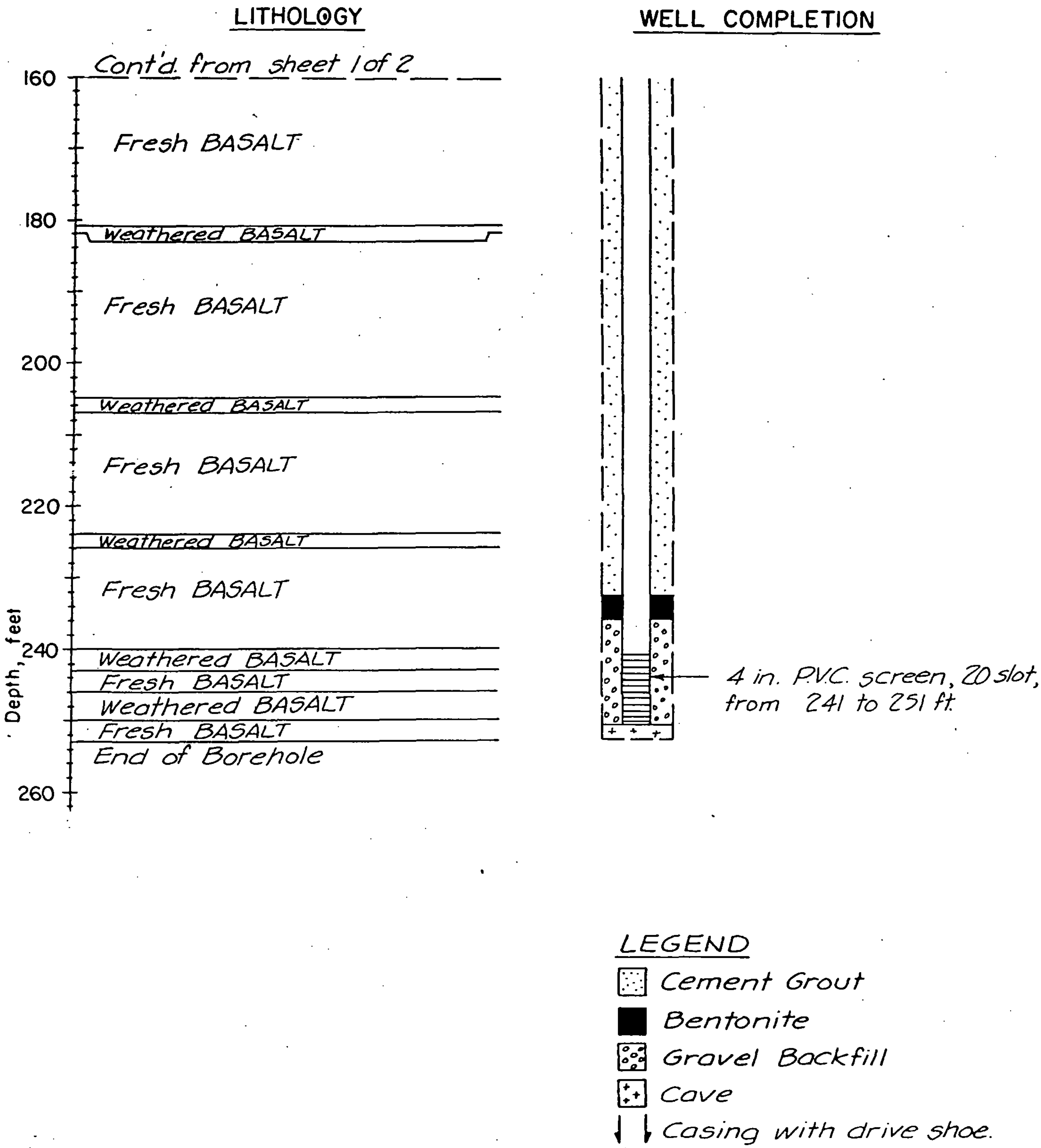
LITHOLOGY AND WELL COMPLETION MONSANTO TW 9	Figure

Sheet 2 of 2



Scale 1 in. to 20 ft.

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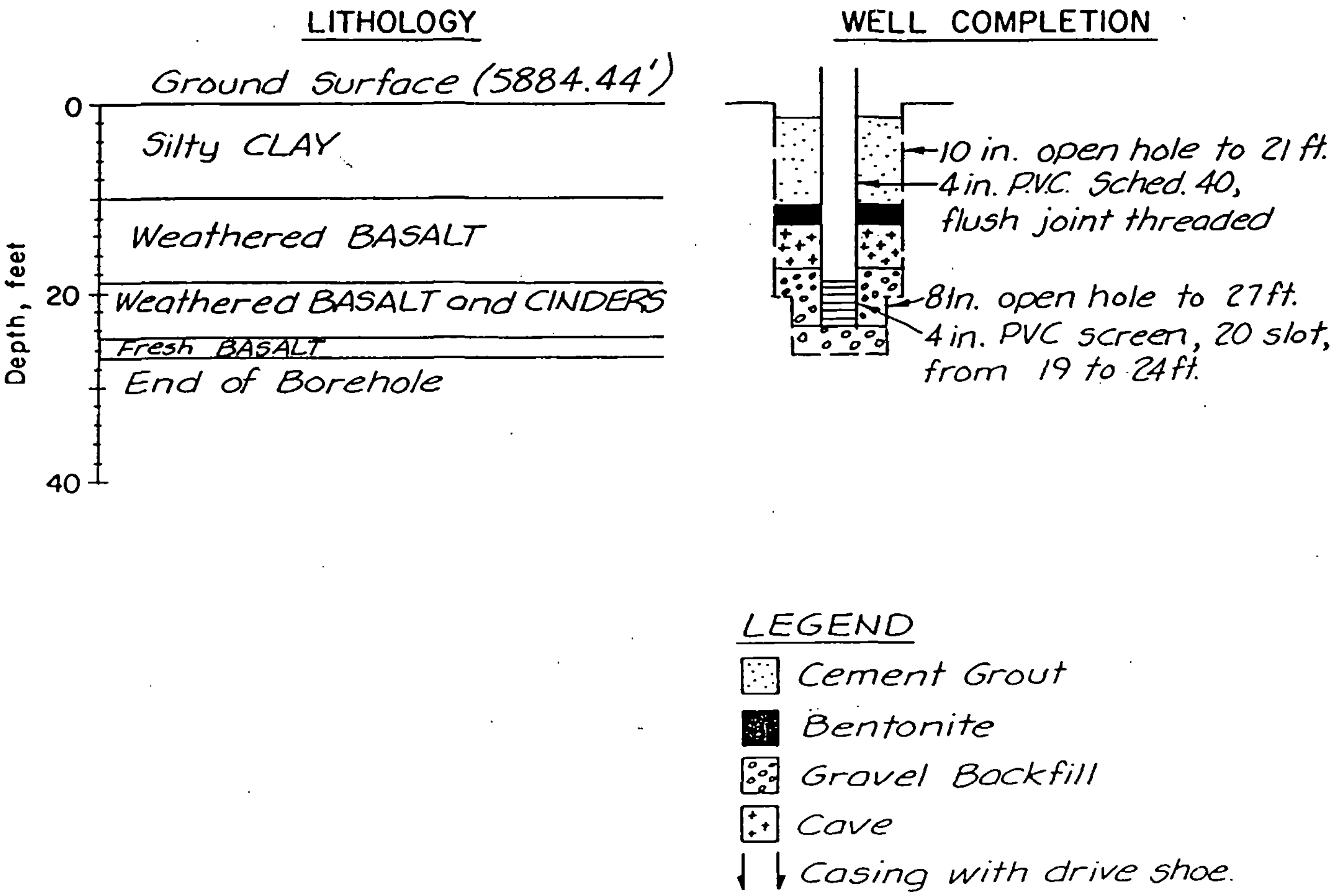
PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 10

Figure A-10



Scale 1 in. to 20 ft.

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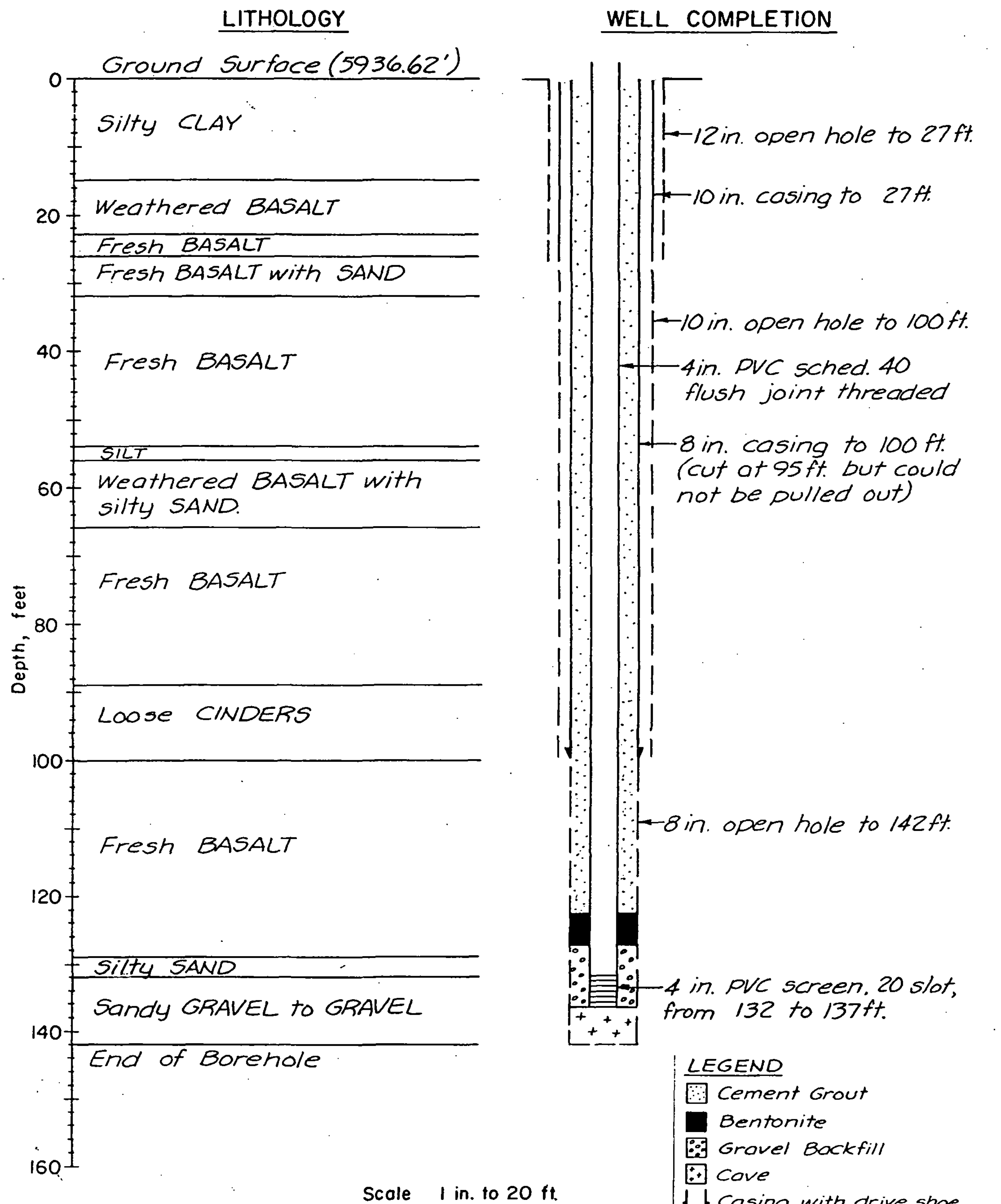
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 11

Figure A-11



PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE Dec. '84

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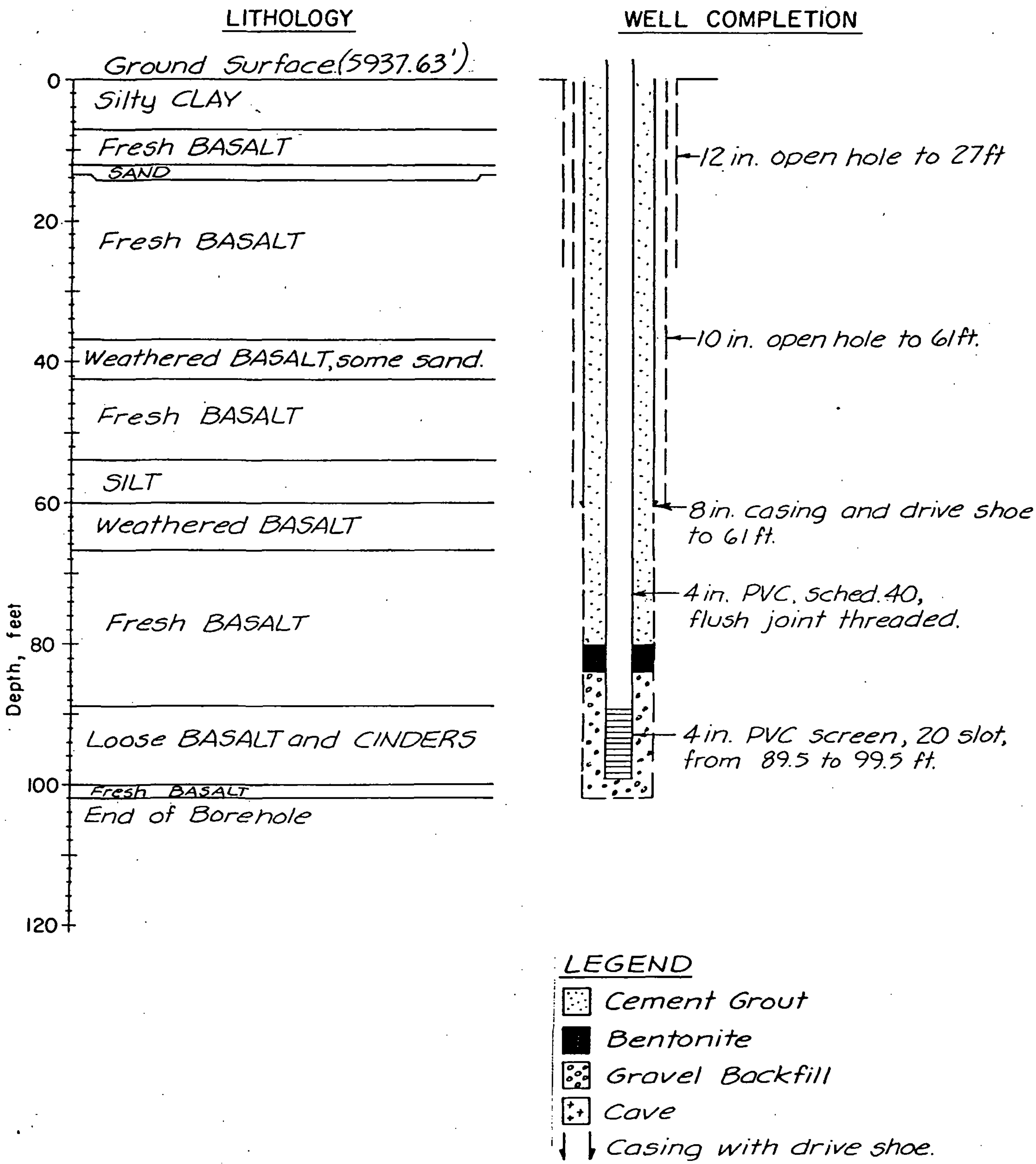
LITHOLOGY AND WELL COMPLETION MONSANTO TW 12	Figure A-12



Scale 1 in. to 20 ft.

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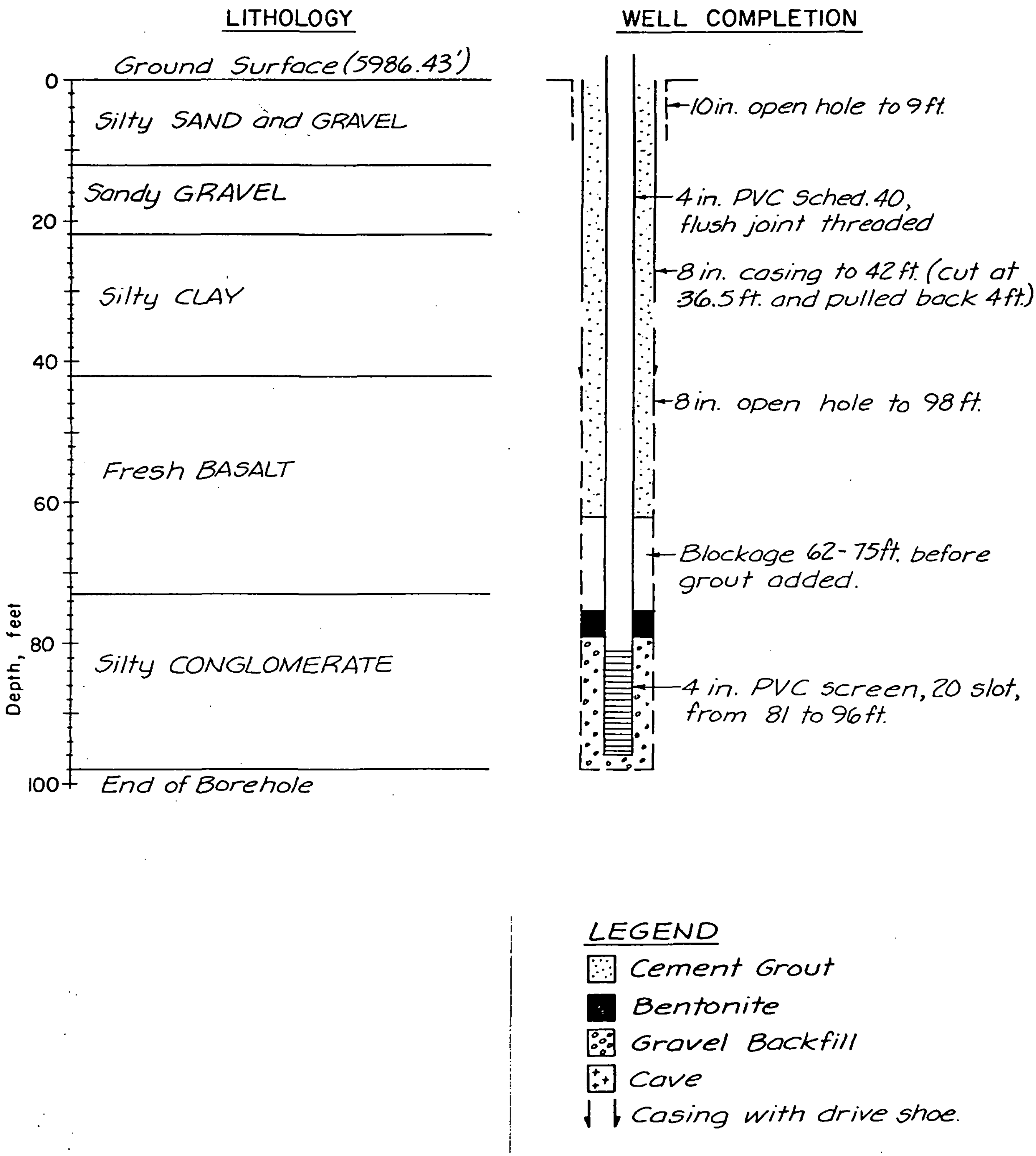
LITHOLOGY AND WELL COMPLETION MONSANTO TW 13

Figure A-13



Scale 1 in. to 20 ft.

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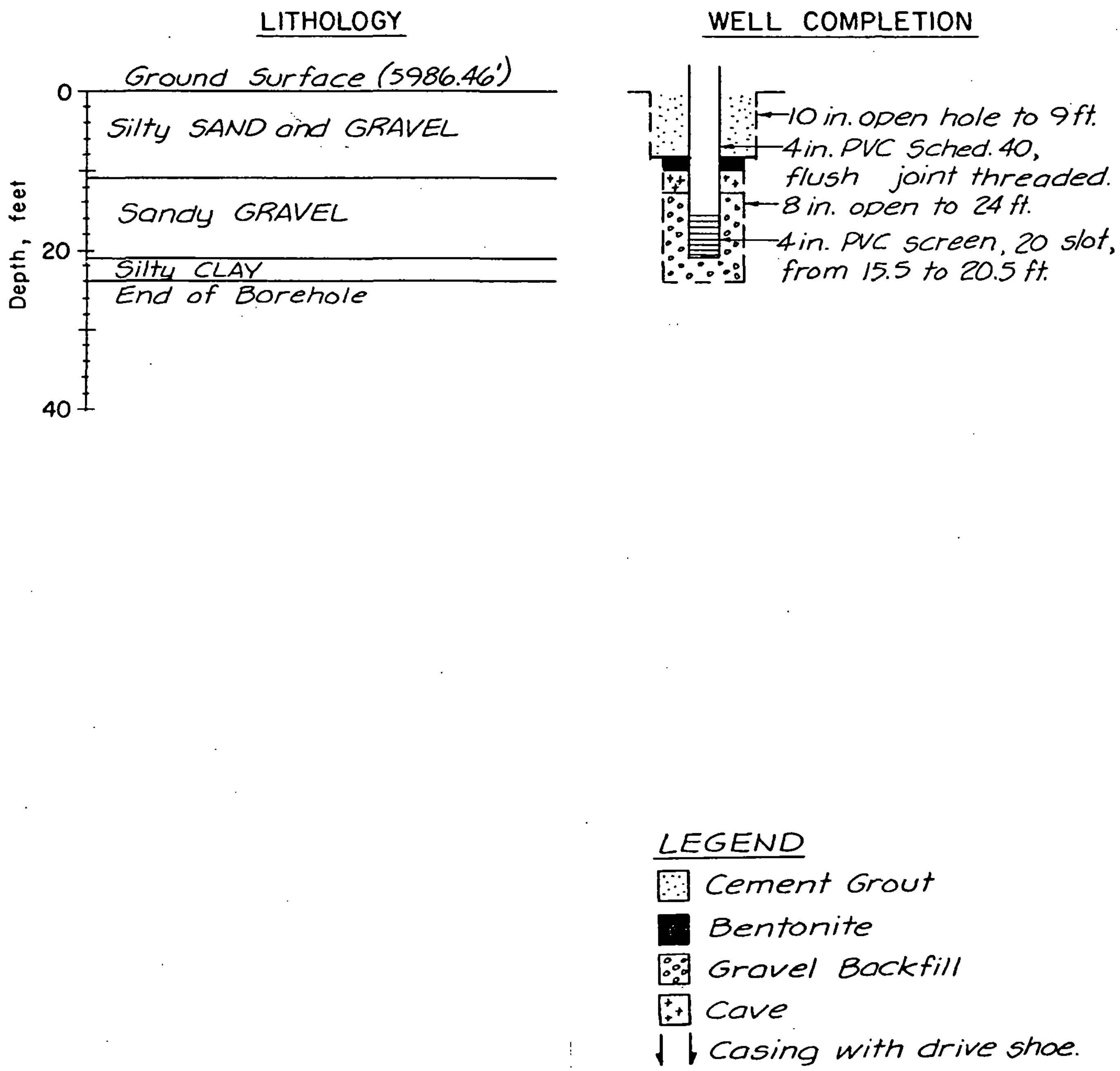
PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 14

Figure A-14



Scale 1 in. to 20 ft.

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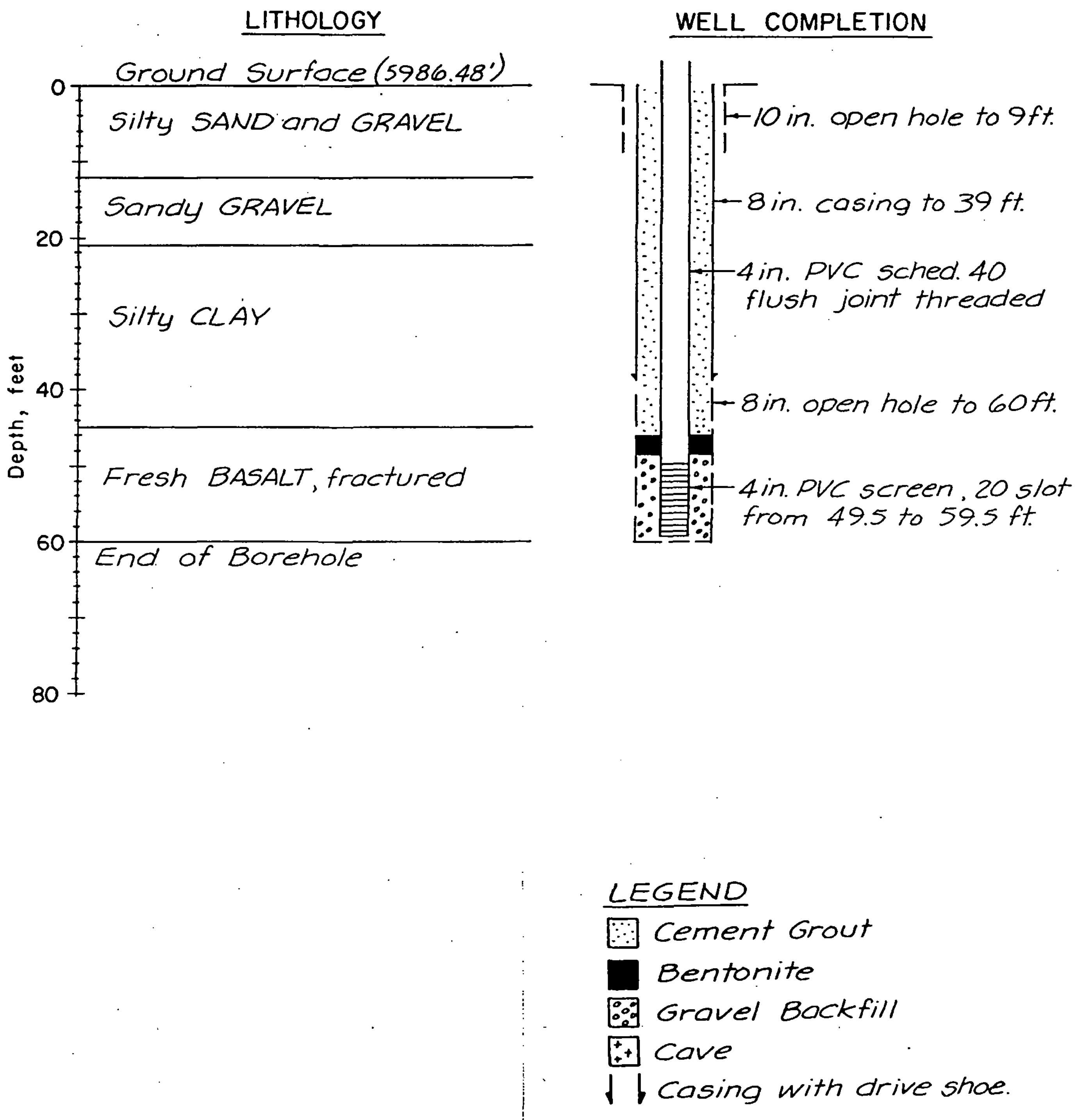
PROJECT NO. 842-1543 DRAWN ...... REVIEWED ...... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 15

Figure A-15

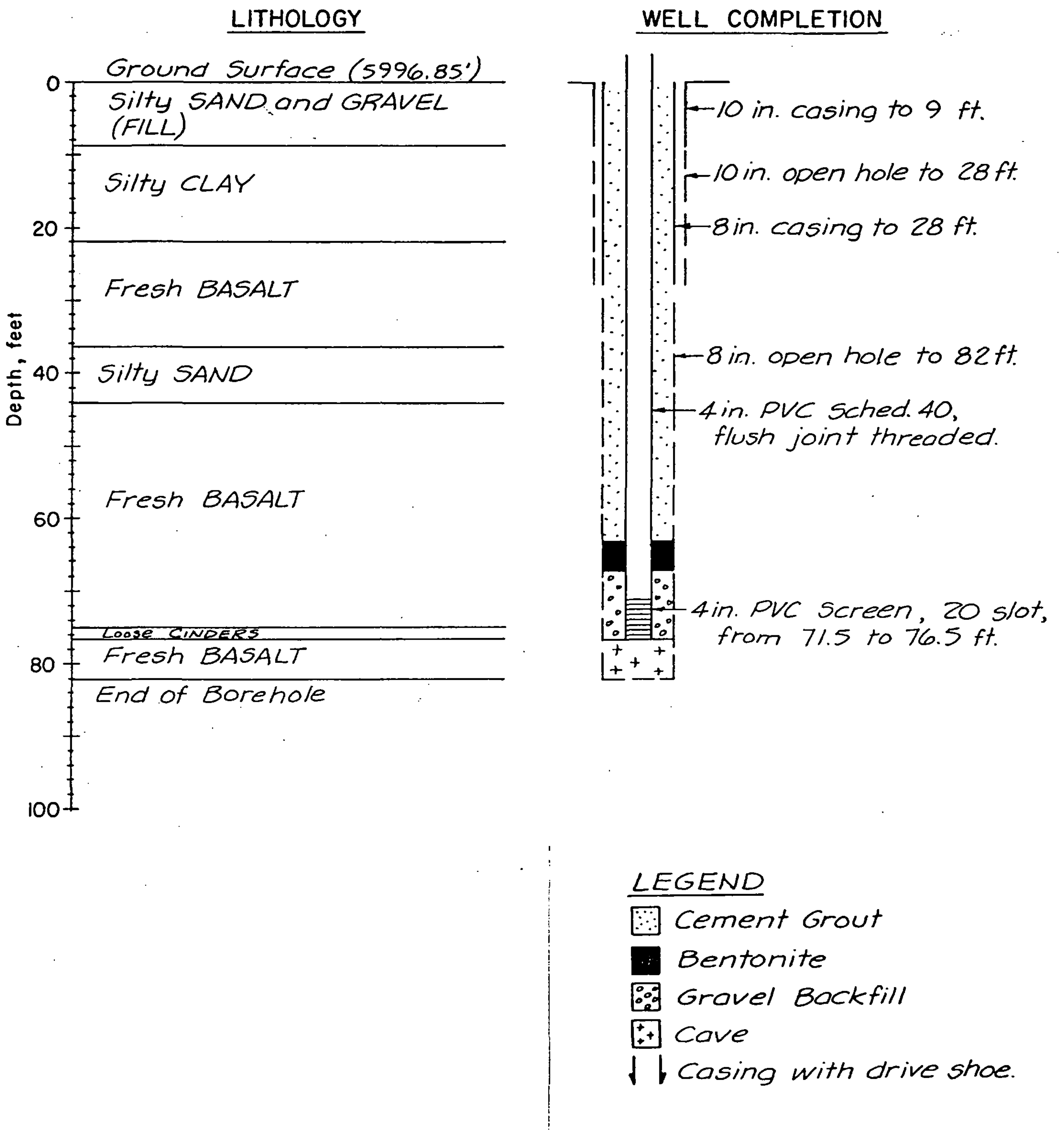


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 16

Figure A-16



Scale 1 in. to 20 ft.

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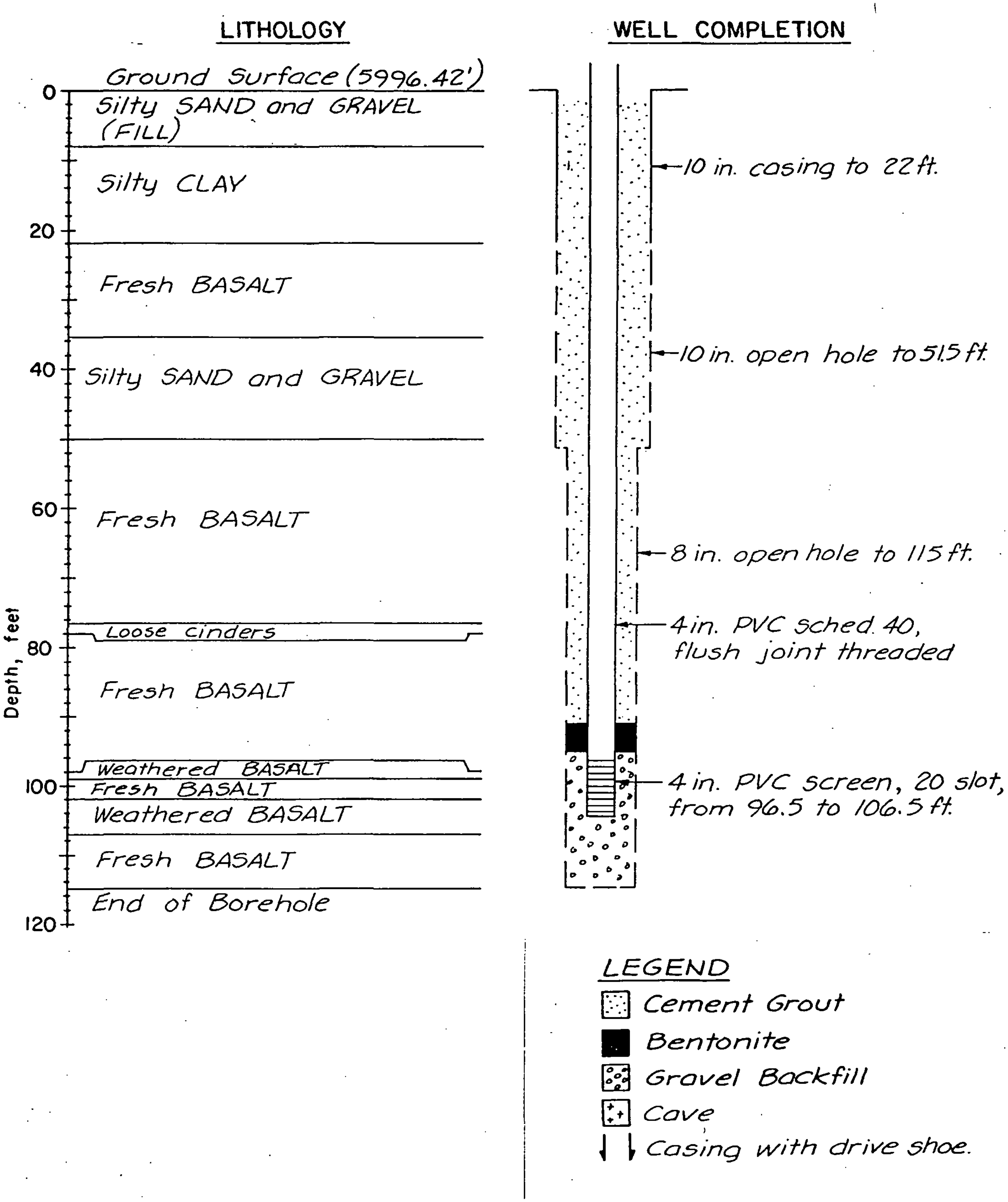
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 17

Figure A-17



Scale 1 in. to 20 ft.

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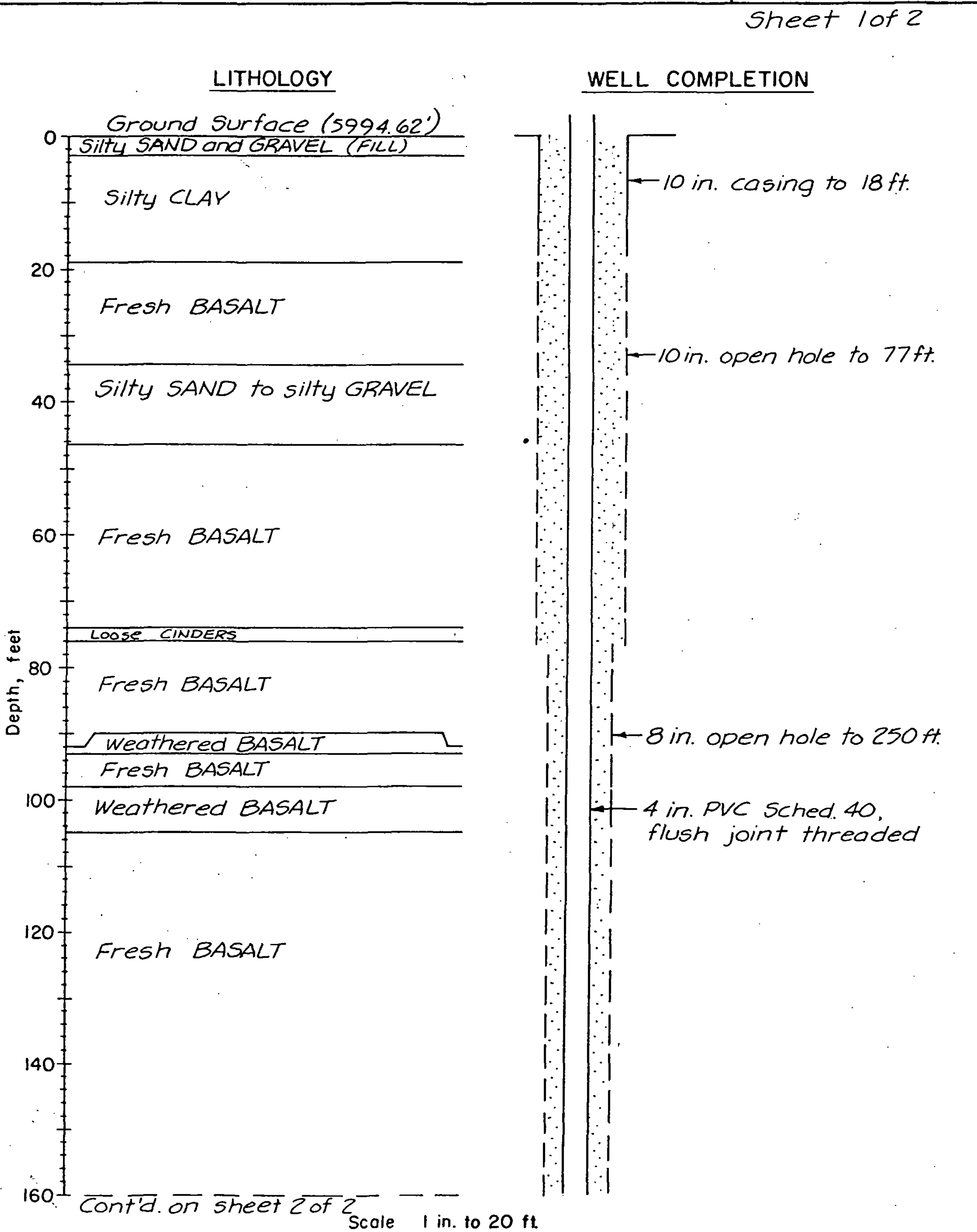
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 18

Figure A-18



PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

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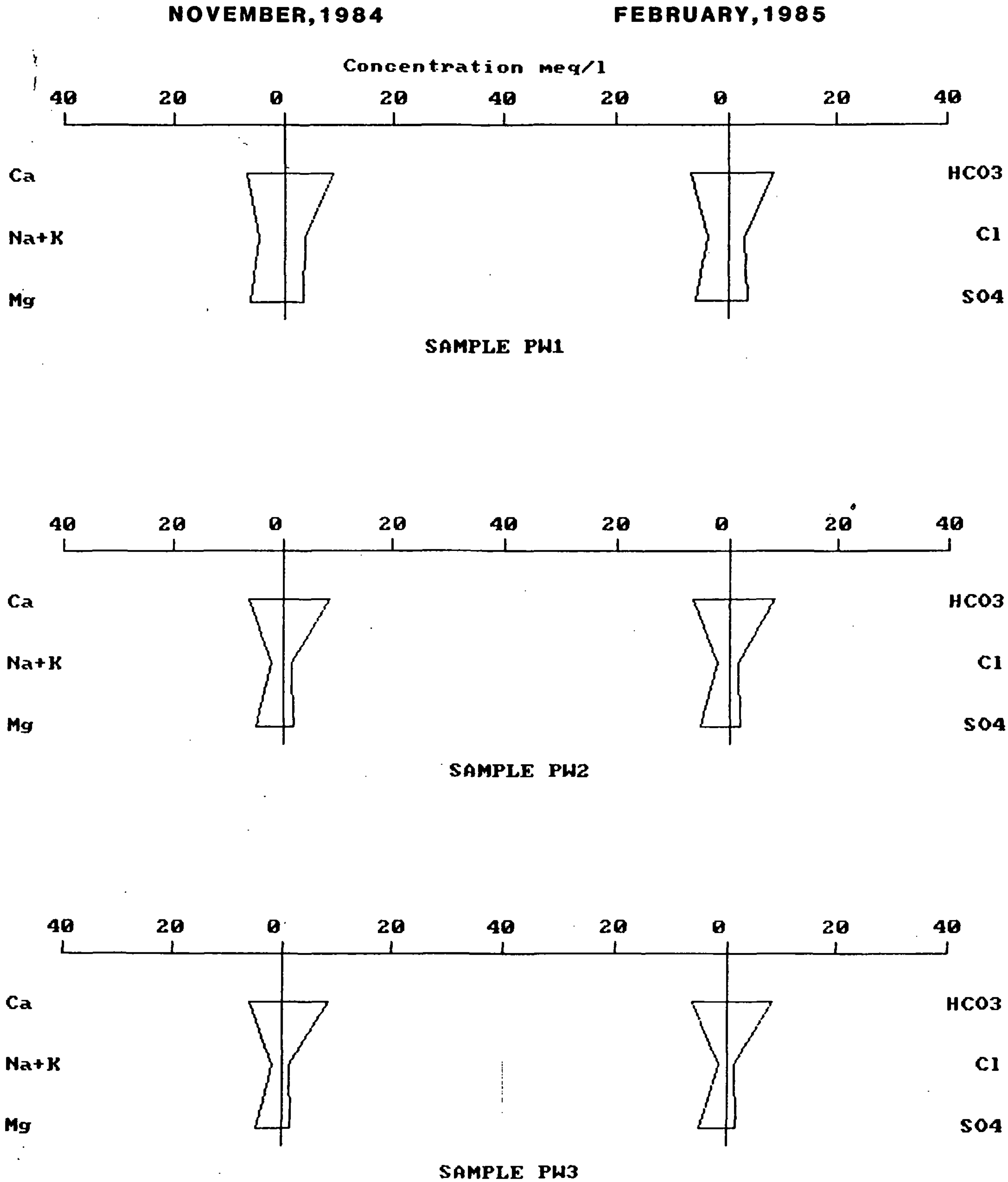
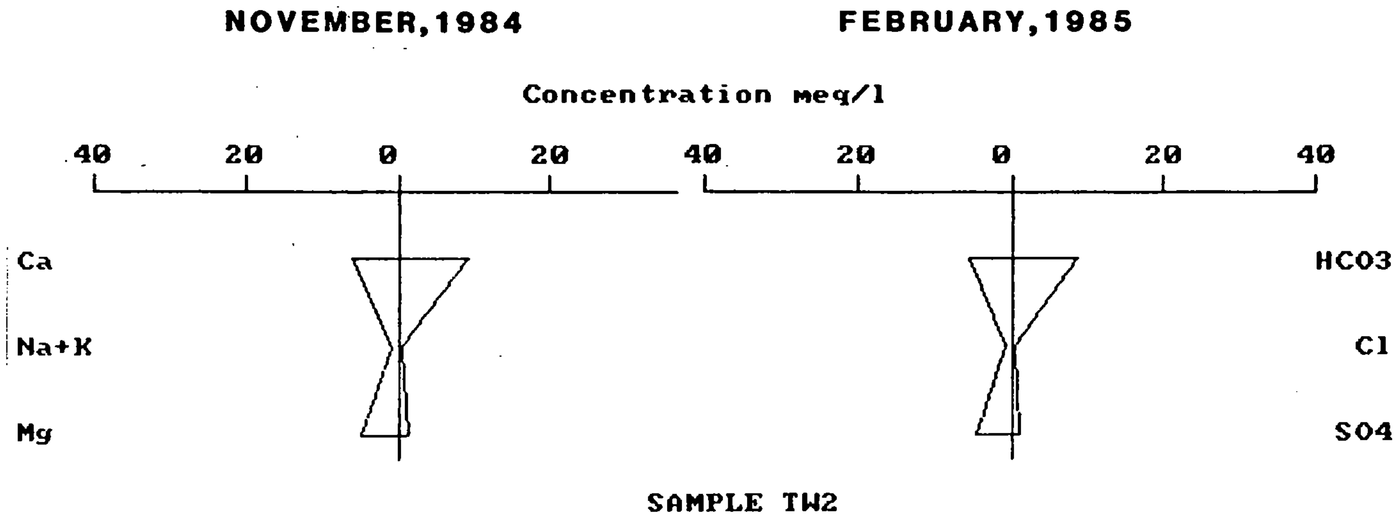
STIFF DIAGRAMS FOR WELLS - PW1 PW2 PW3

Figure **B-1**



PROJECT NO. 842-1543 DRAWN - REVIEWED DATE Apr. '85

STIFF DIAGRAMS FOR TEST WELL -TW2	Figure B-2



PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

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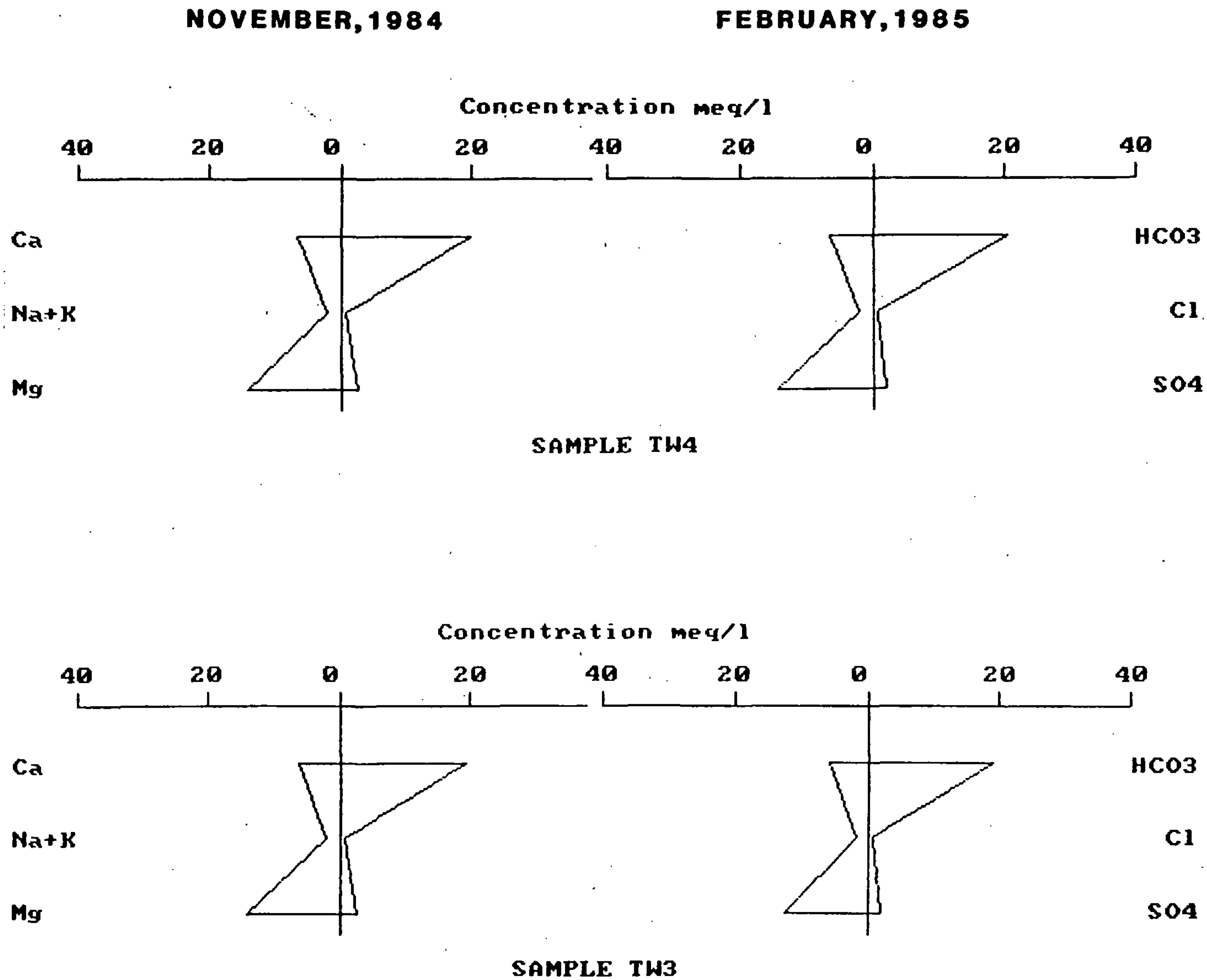
STIFF DIAGRAMS FOR TEST WELLS TW4 AND TW5

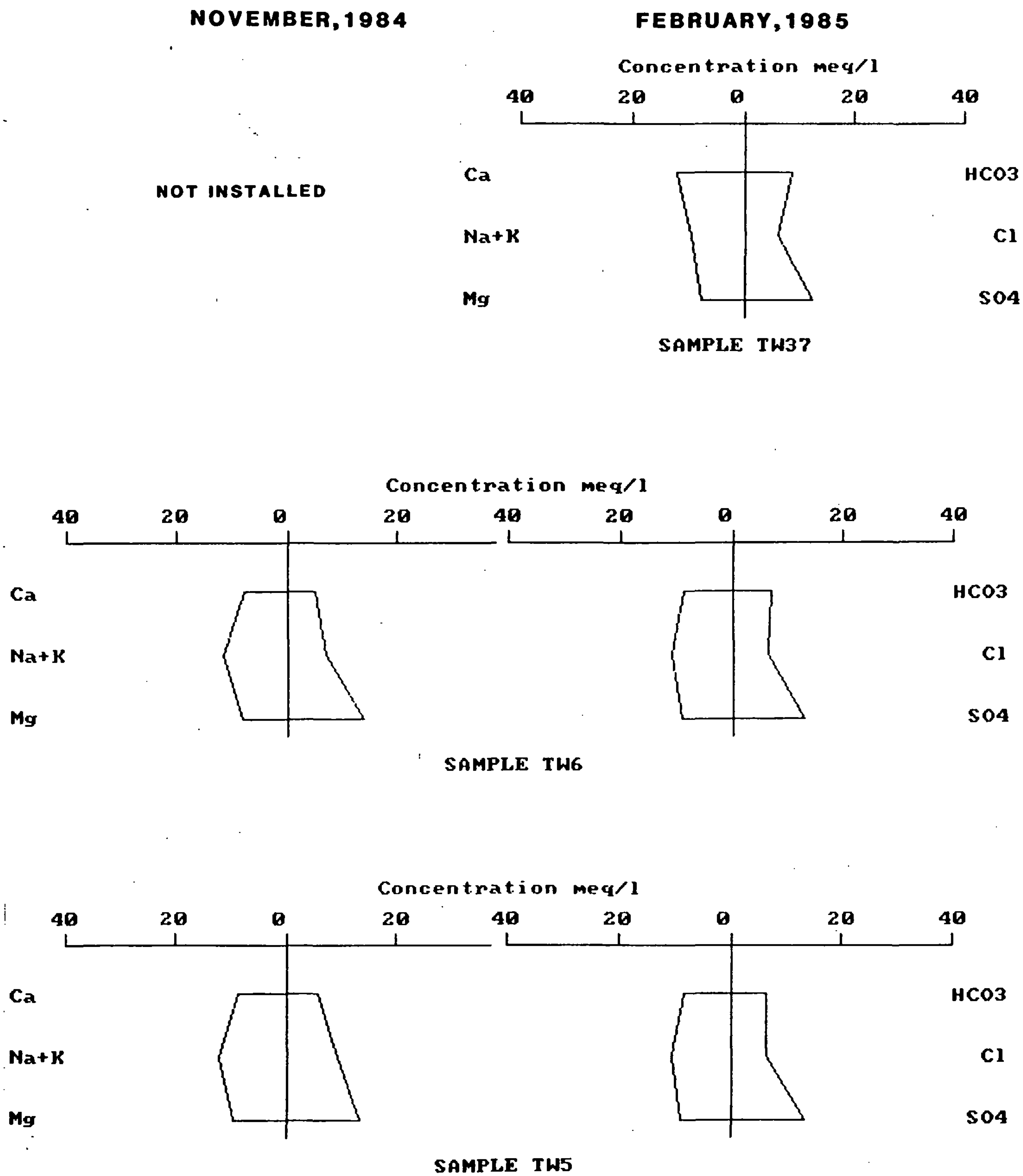
Figure B-3



DATE
REVIEWED
DRAWN
PROJECT NO.

STIFF DIAGRAMS FOR TEST WELLS TW37, TW6 AND TW5

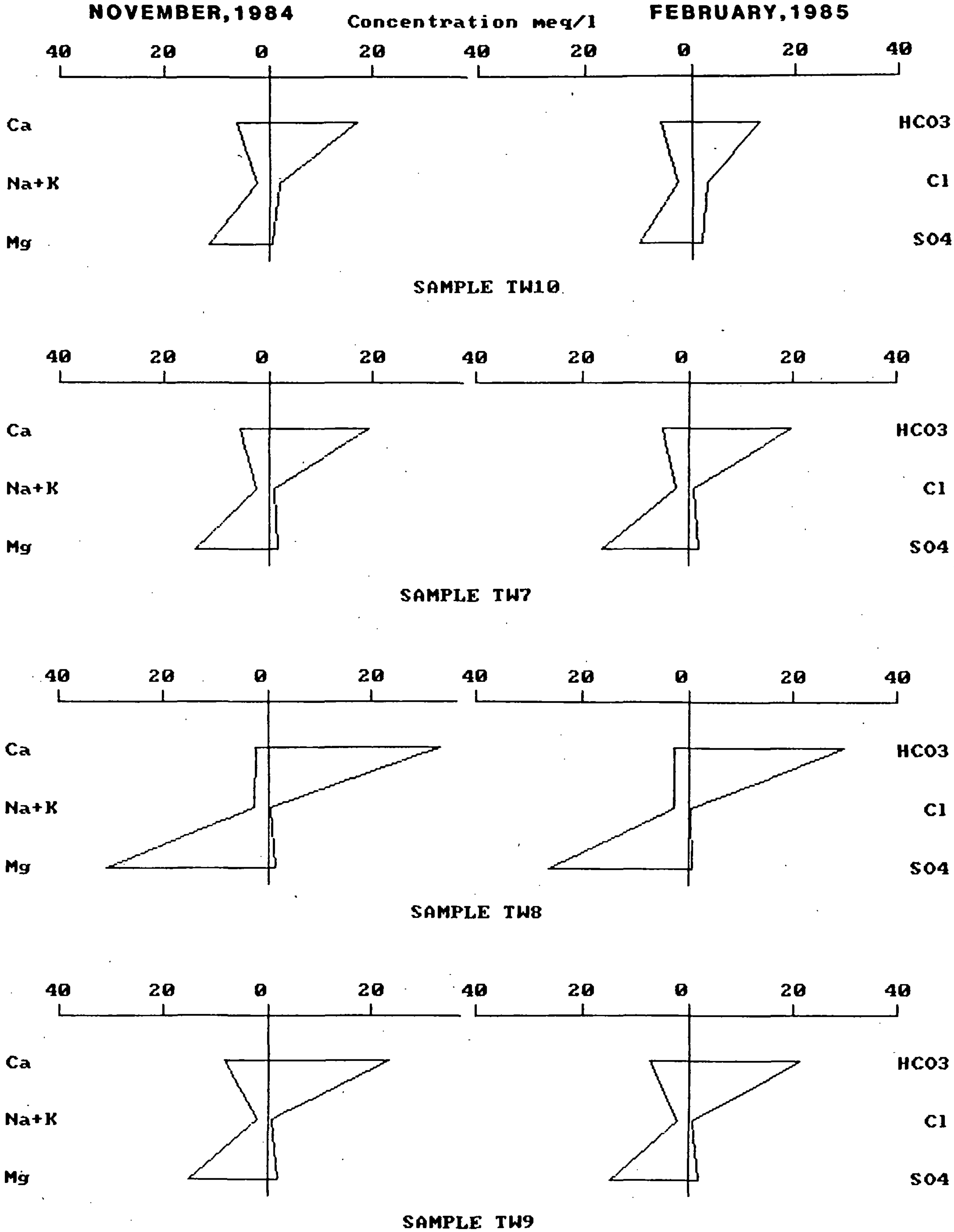
Figure B-4



PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

STIFF DIAGRAMS FOR TEST WELLS TW10, TW7, TW8 AND TW9

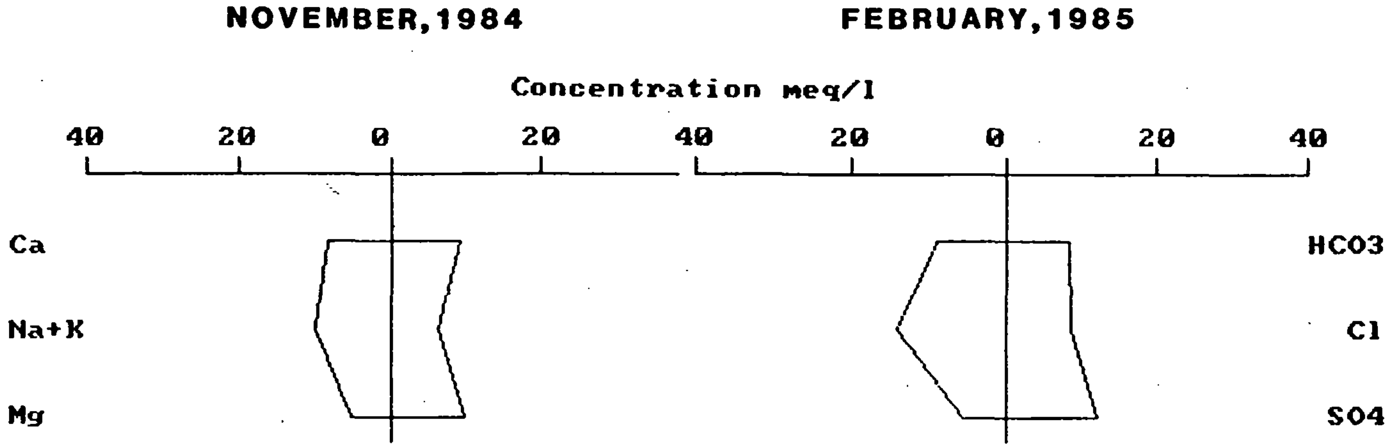
Figure B-5



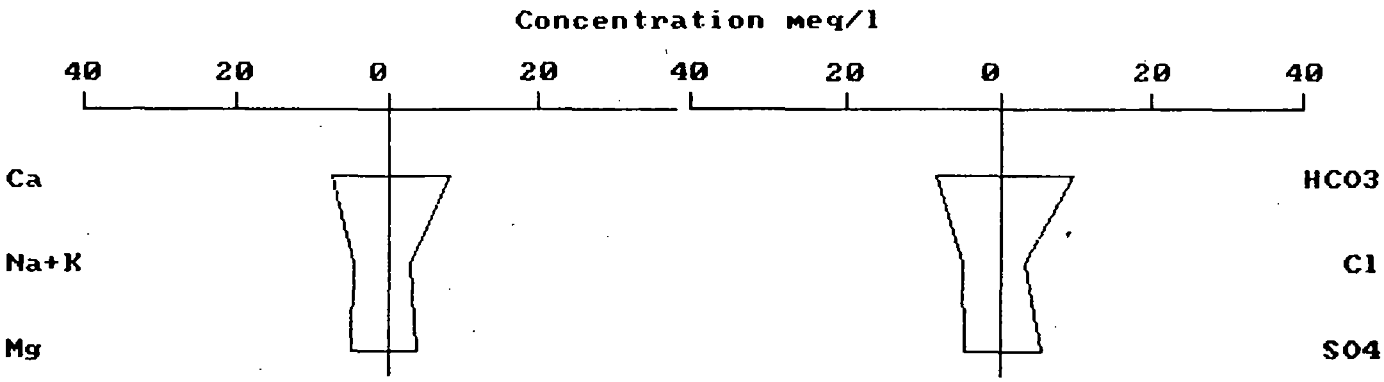
PROJECT NO. DRAWN REVIEWED DATE

STIFF DIAGRAMS FOR TEST WELLS TW12 AND TW11

Figure B-6



SAMPLE TW12

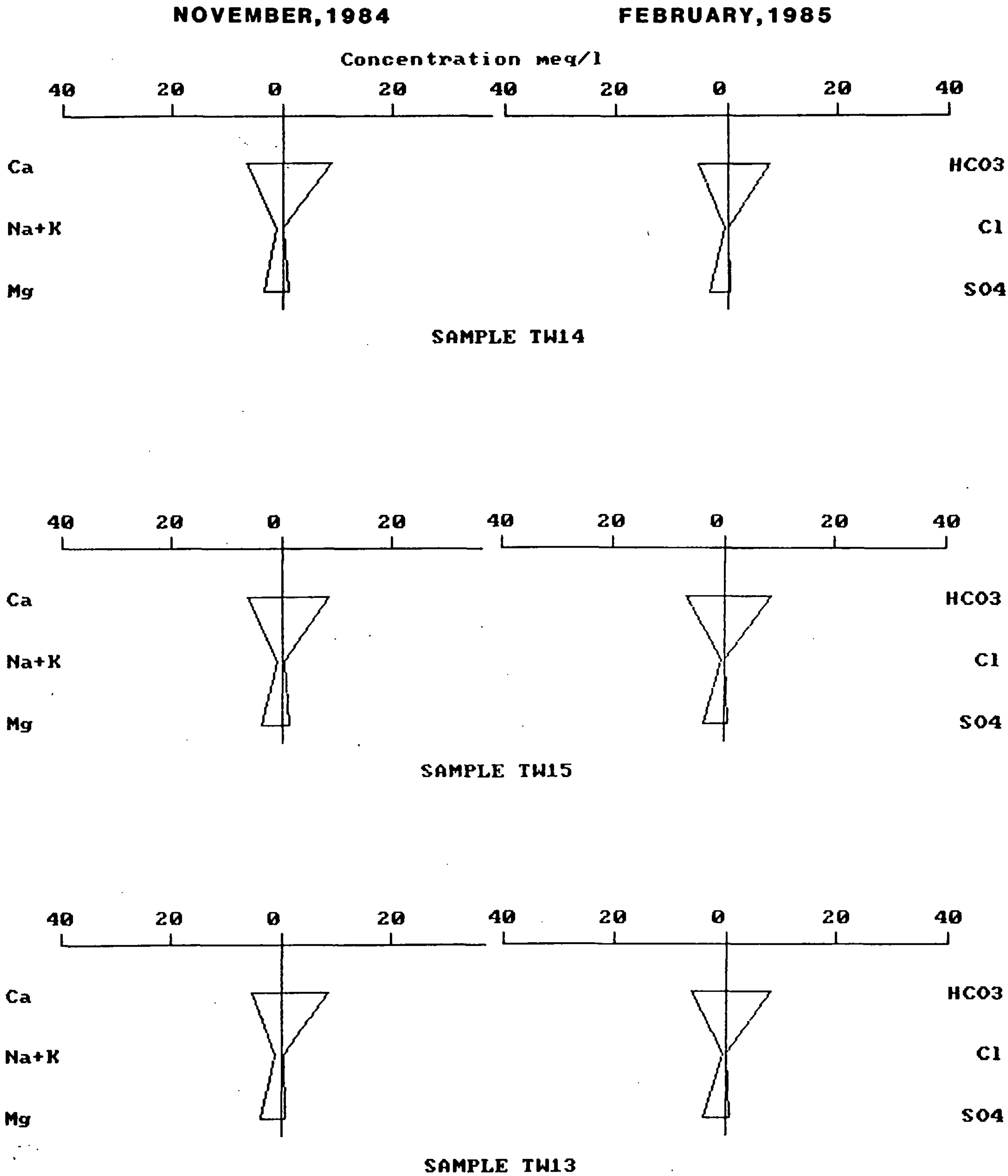


SAMPLE TW11

PROJECT NO. DRAWN REVIEWED DATE

STIFF DIAGRAMS FOR TEST WELLS TW14, TW15 AND TW13

Figure B-7



PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

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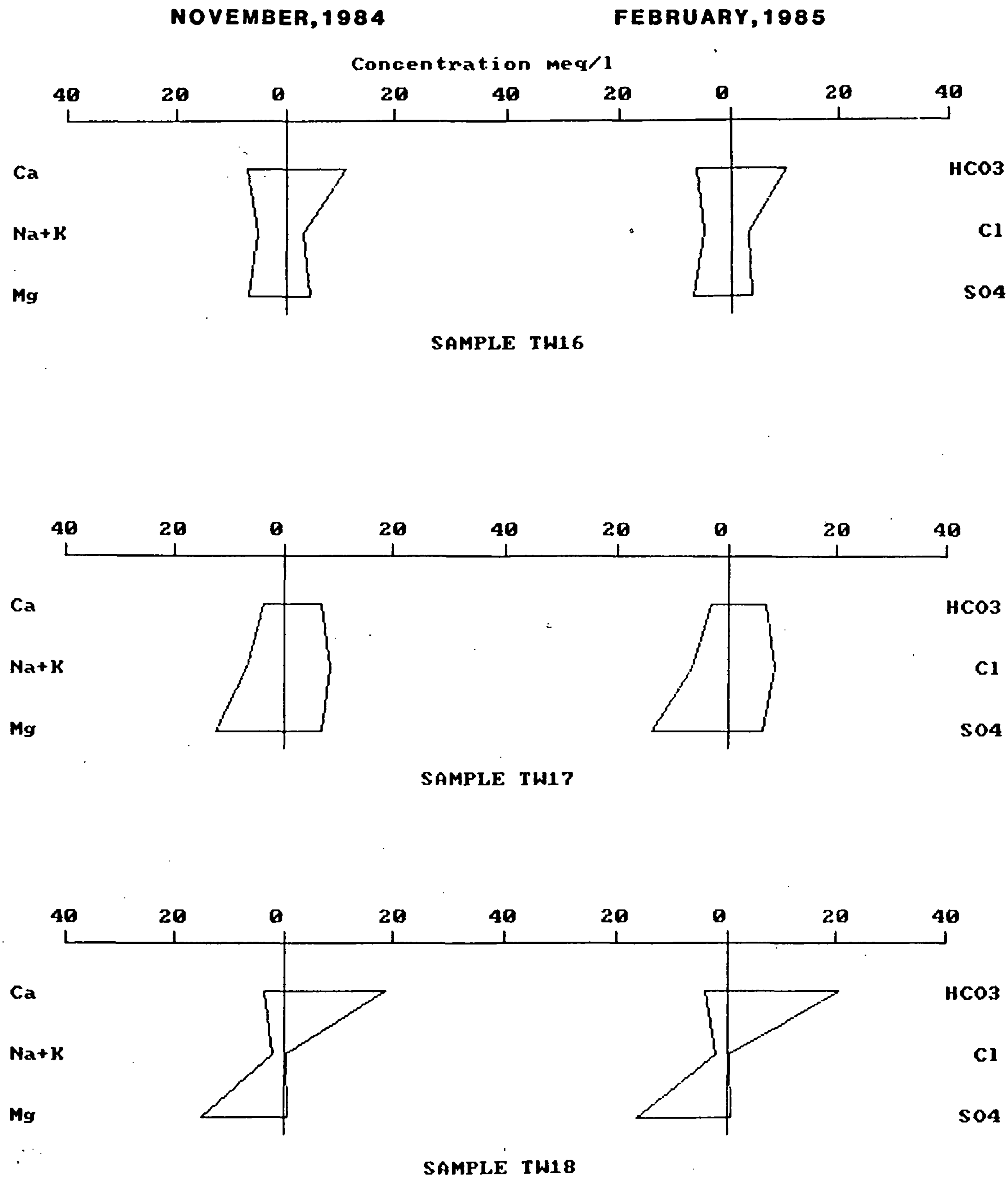
STIFF DIAGRAMS FOR TEST WELLS TW16, TW17 AND TW18

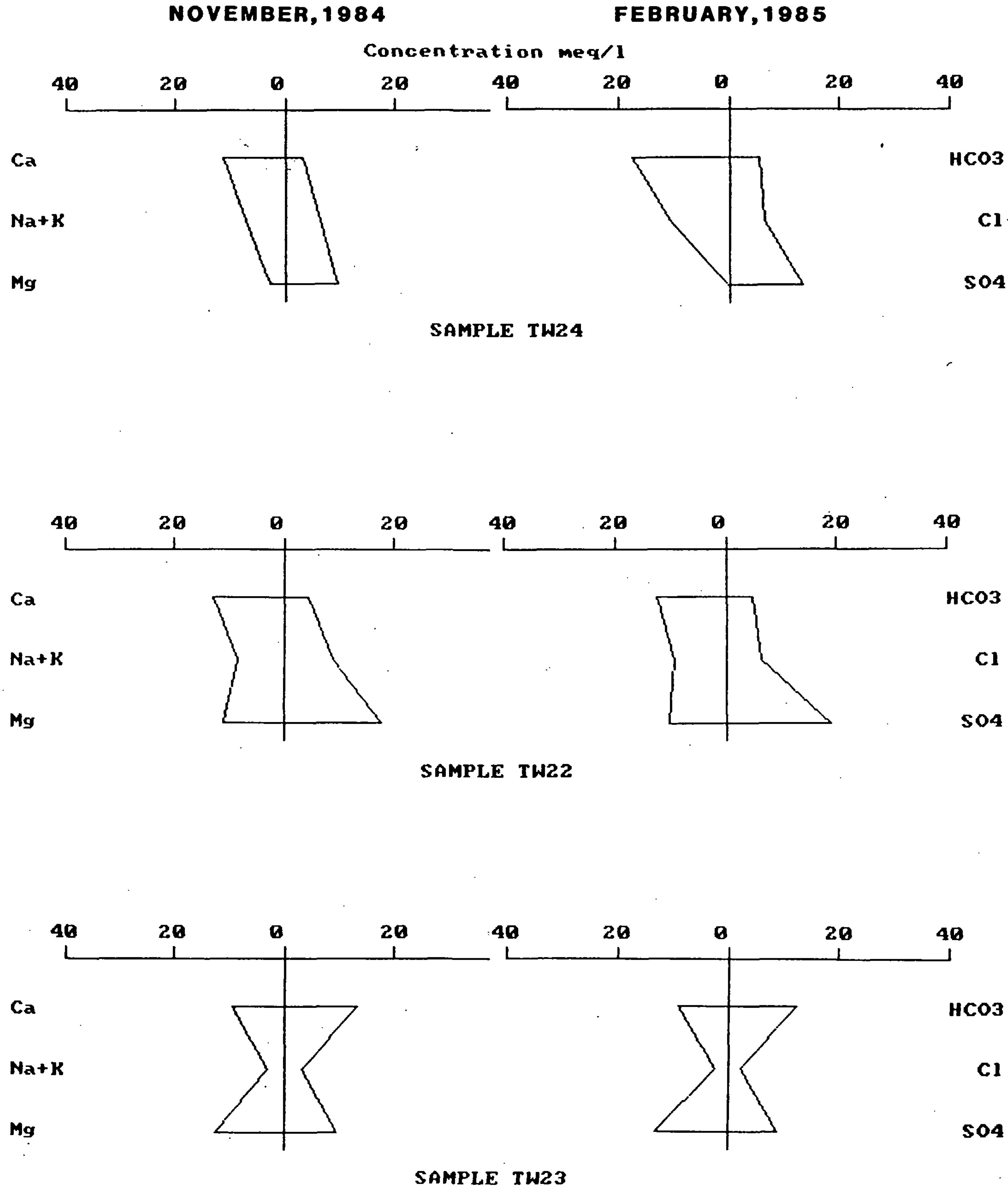
Figure B-8



PROJECT NO. DRAWN REVIEWED DATE

STIFF DIAGRAMS FOR TEST WELLS TW24, TW22 AND TW23

Figure B-9



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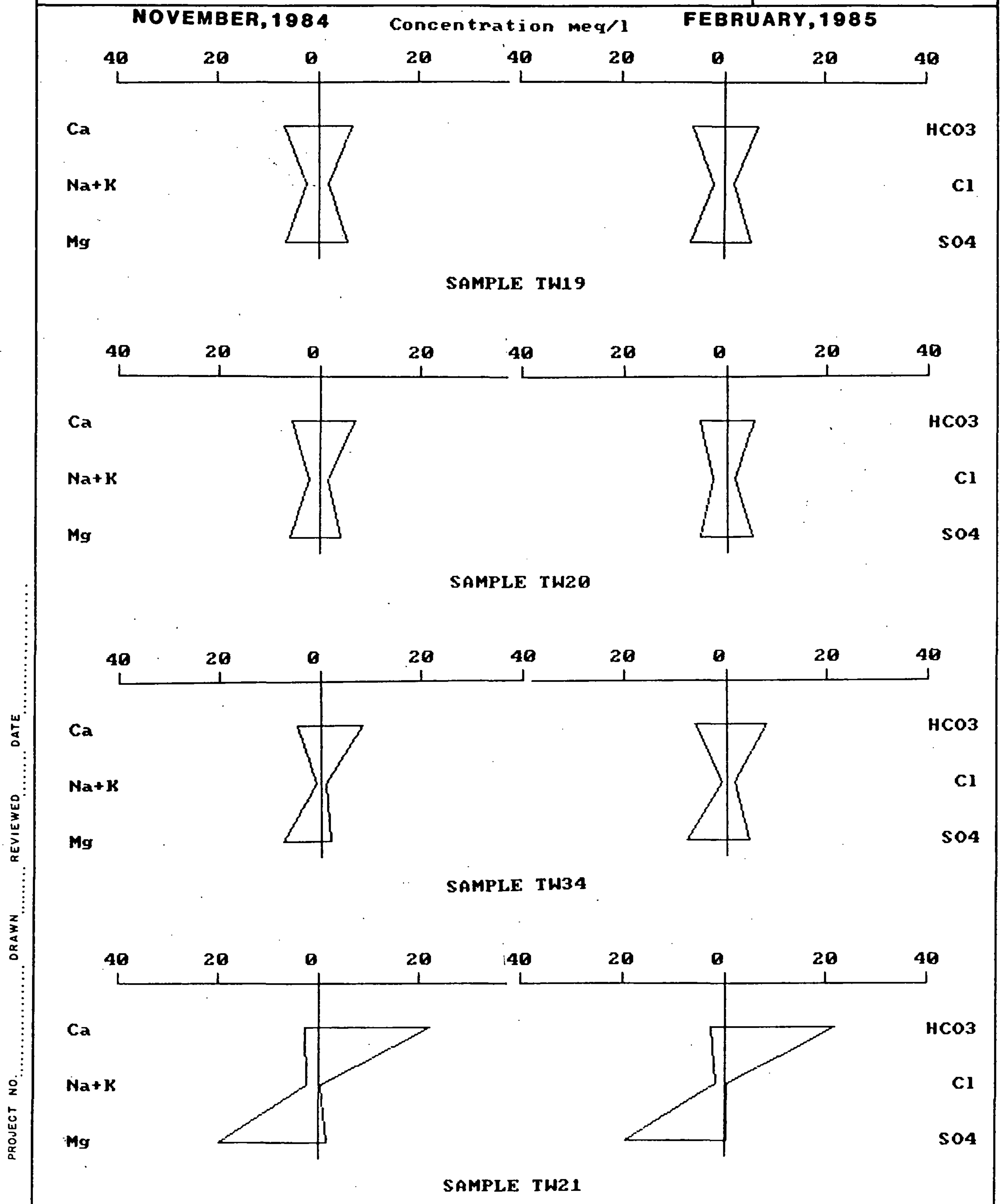
PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

STIFF DIAGRAMS FOR TEST WELLS TW19, TW20, TW34 AND TW21

Figure B-10



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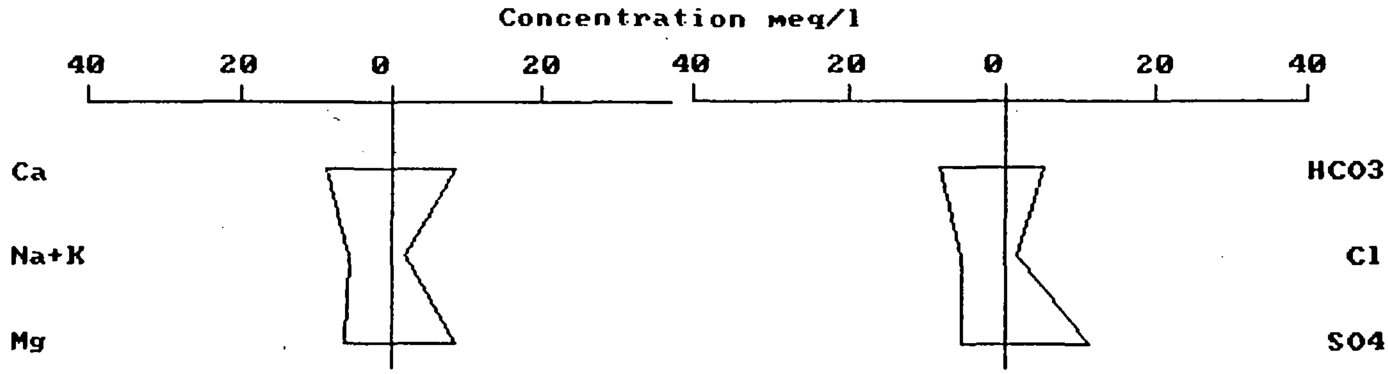
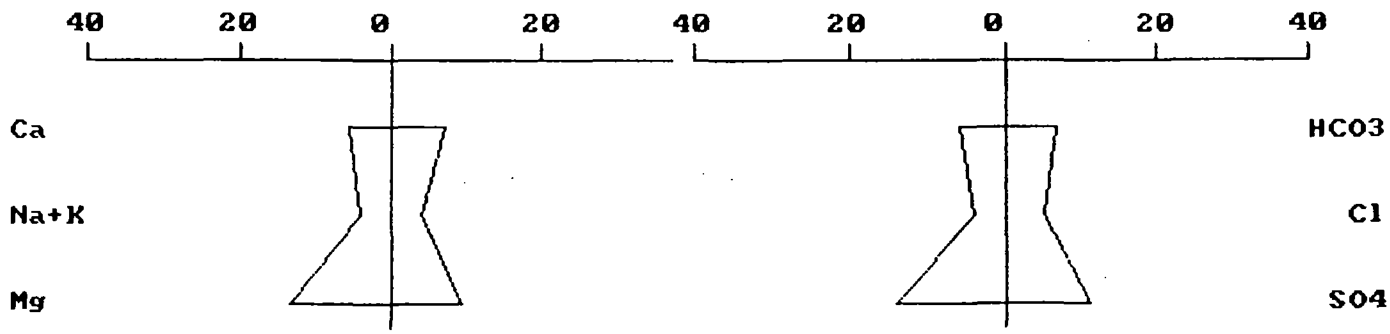
STIFF DIAGRAMS FOR TEST WELLS TW27, TW26 AND TW25

Figure B-11

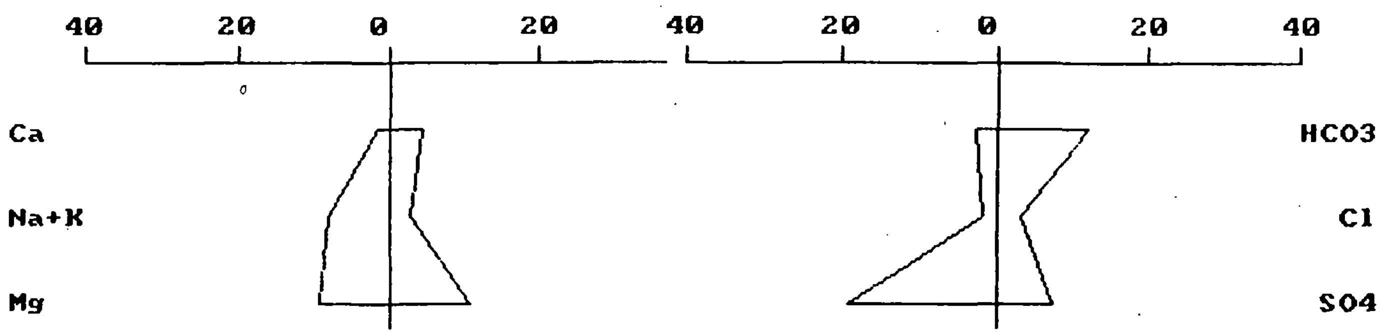
NOVEMBER,1984 FEBRUARY,1985



SAMPLE TW27



SAMPLE TW26

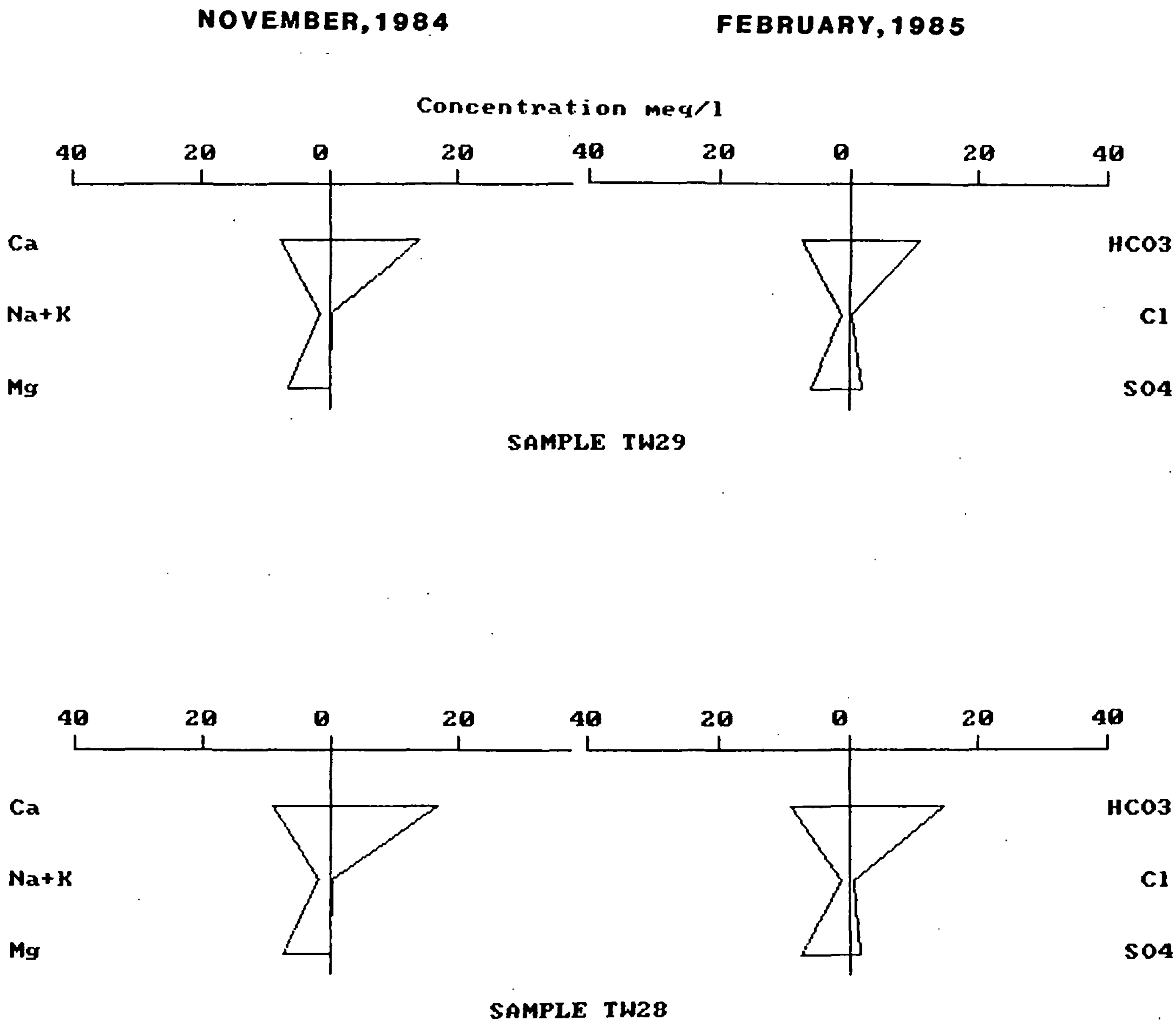


SAMPLE TW25

PROJECT NO. DRAWN REVIEWED DATE

STIFF DIAGRAMS FOR TEST WELLS TW29 AND TW28

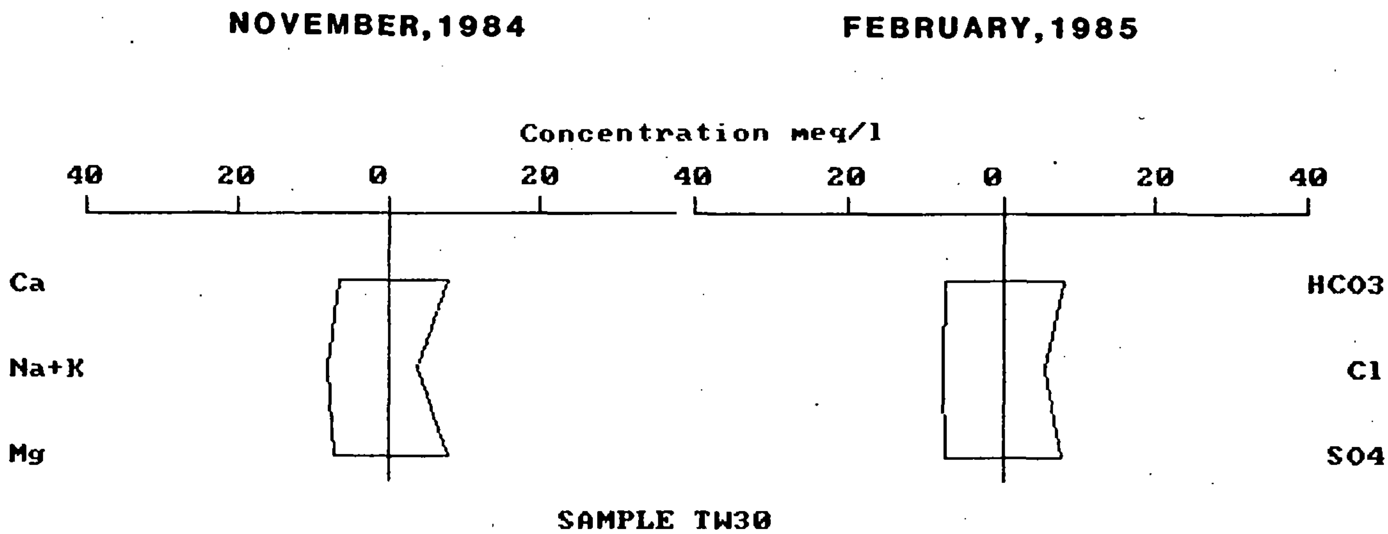
Figure B-12



PROJECT NO. DRAWN REVIEWED DATE

STIFF DIAGRAMS FOR TEST WELLS
TW30

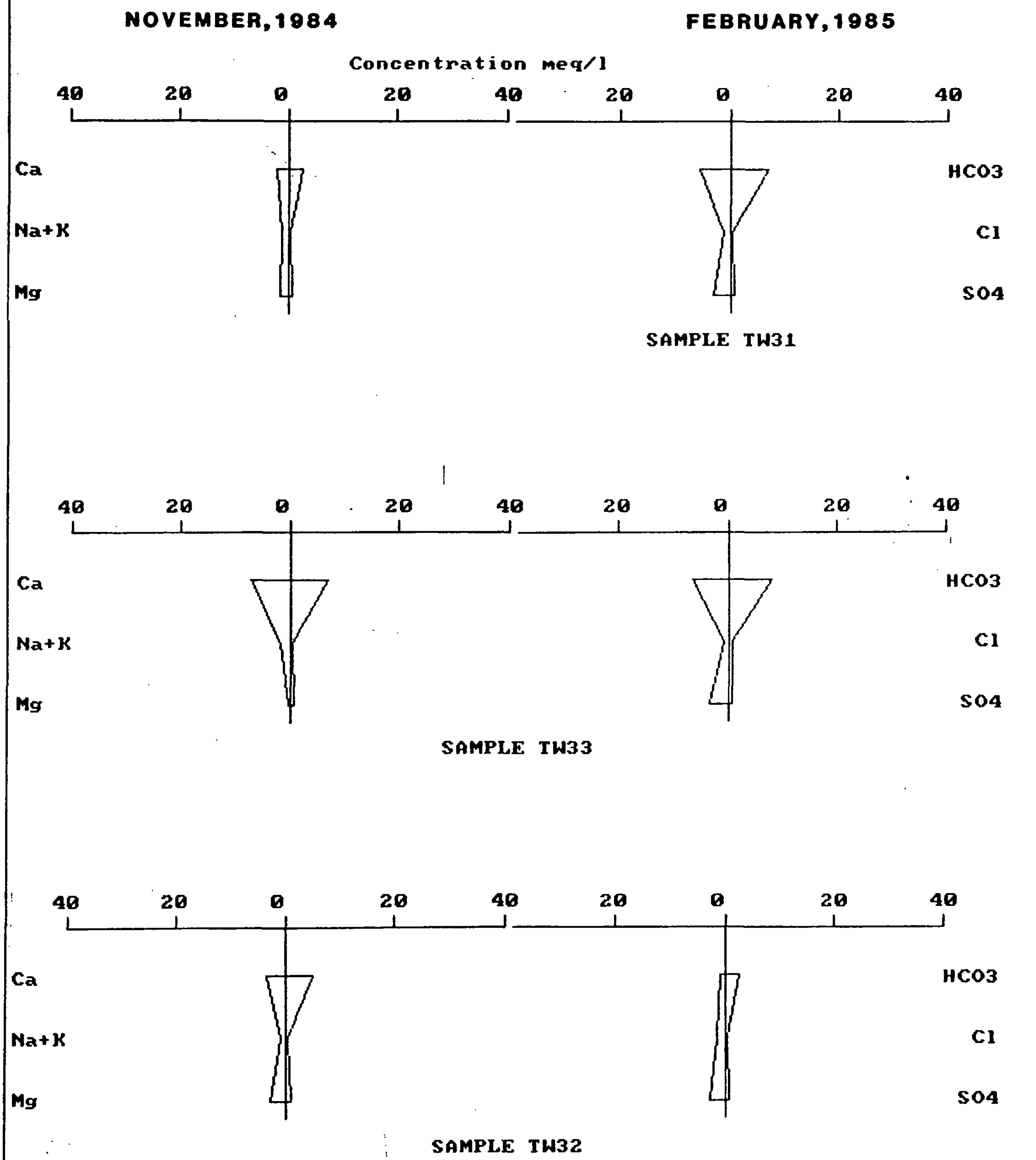
Figure B-13



PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

STIFF DIAGRAMS FOR TEST WELLS TW31, TW33 AND TW32

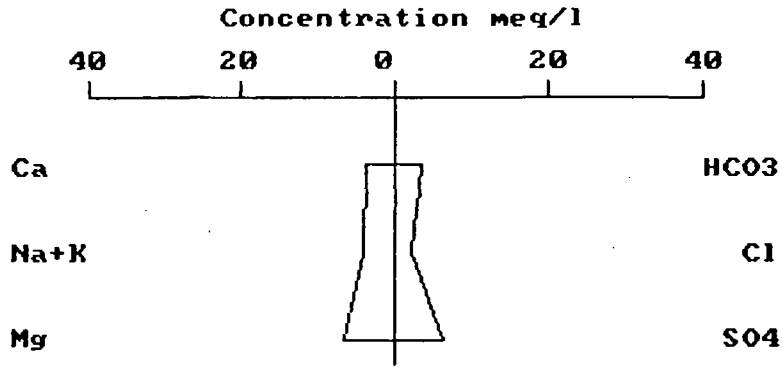
Figure **B-14**



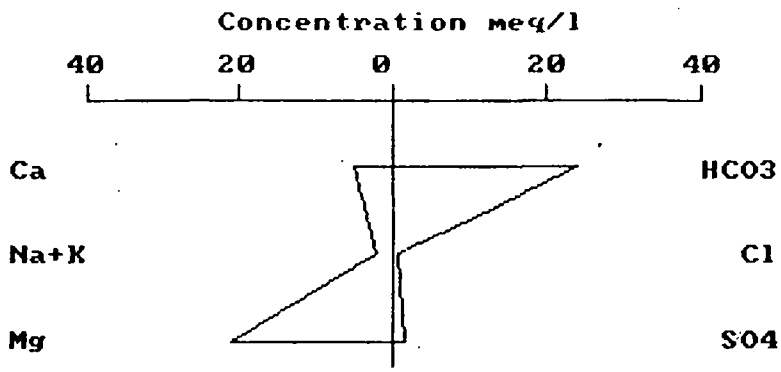
STIFF DIAGRAMS FOR TEST WELLS TW39 AND TW35

Figure **B-15**

FEBRUARY,1985



SAMPLE TW39



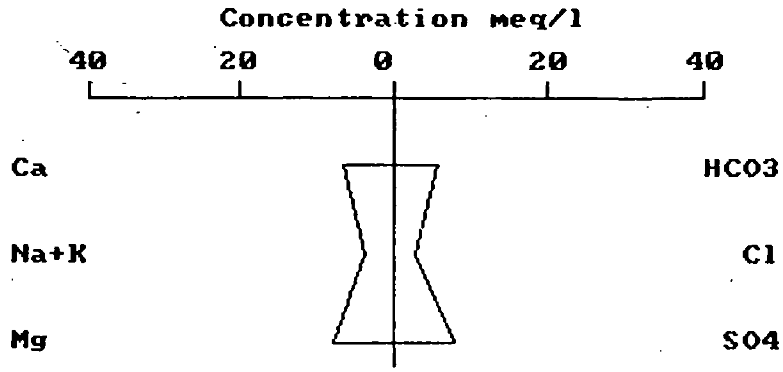
SAMPLE TW35

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

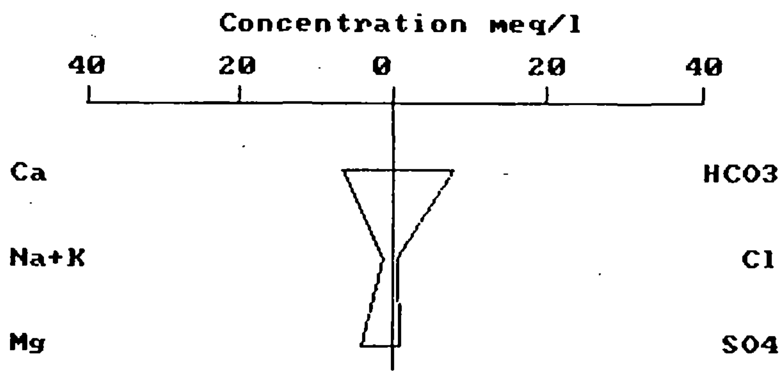
STIFF DIAGRAMS FOR TEST WELLS TW36, TW38 AND TW40

Figure B-16

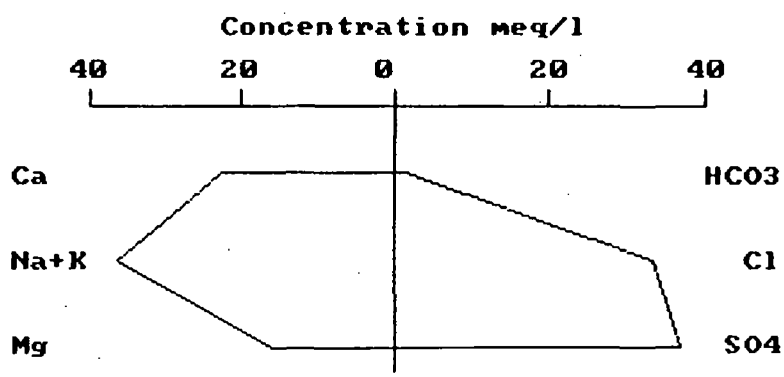
FEBRUARY,1985



SAMPLE TW36



SAMPLE TW38

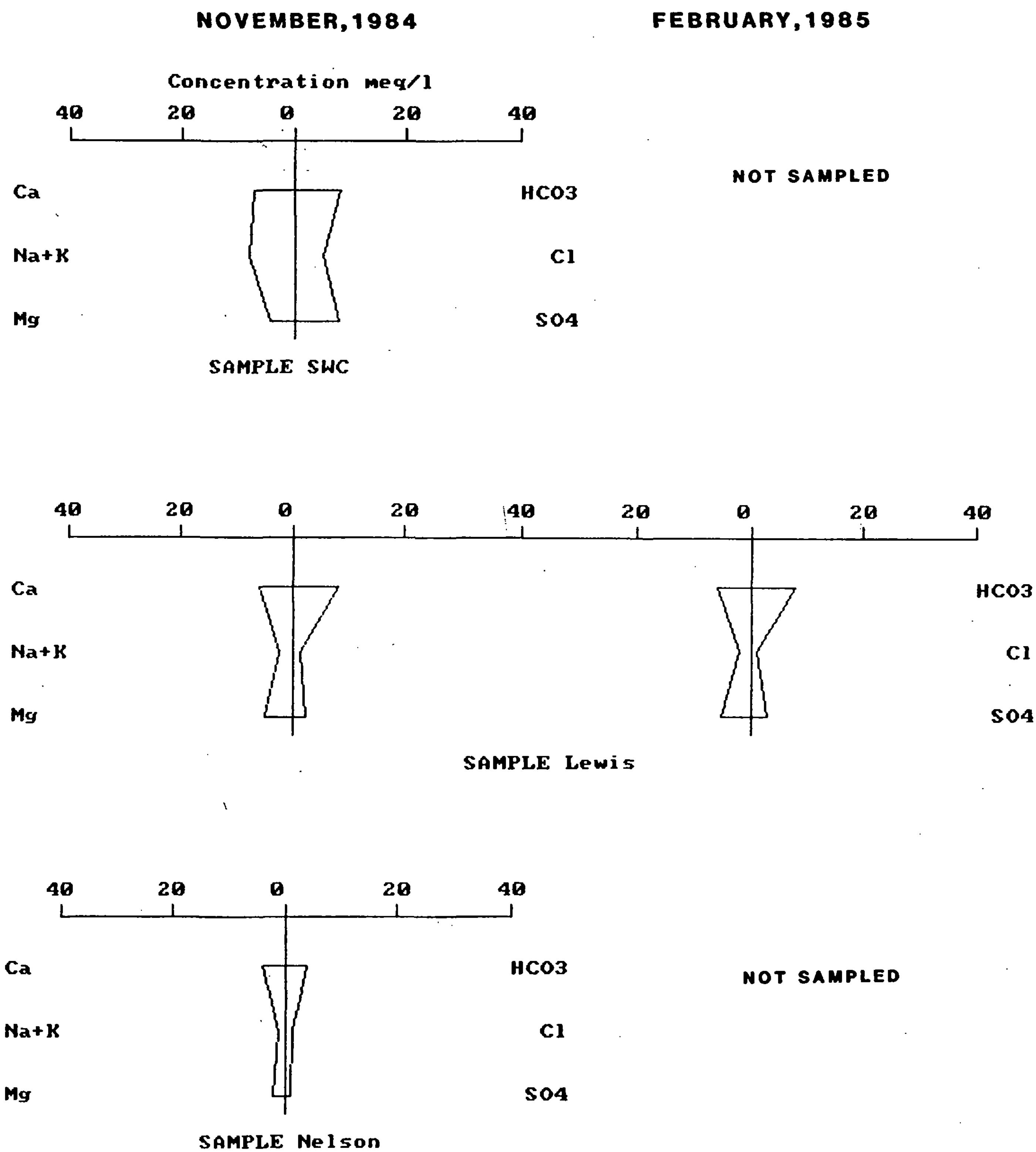


SAMPLE TW40

PROJECT NO. .... DRAWN .... REVIEWED .... DATE ....

STIFF DIAGRAMS FOR WELLS SWC, LEWIS AND NELSON

Figure **B-17**



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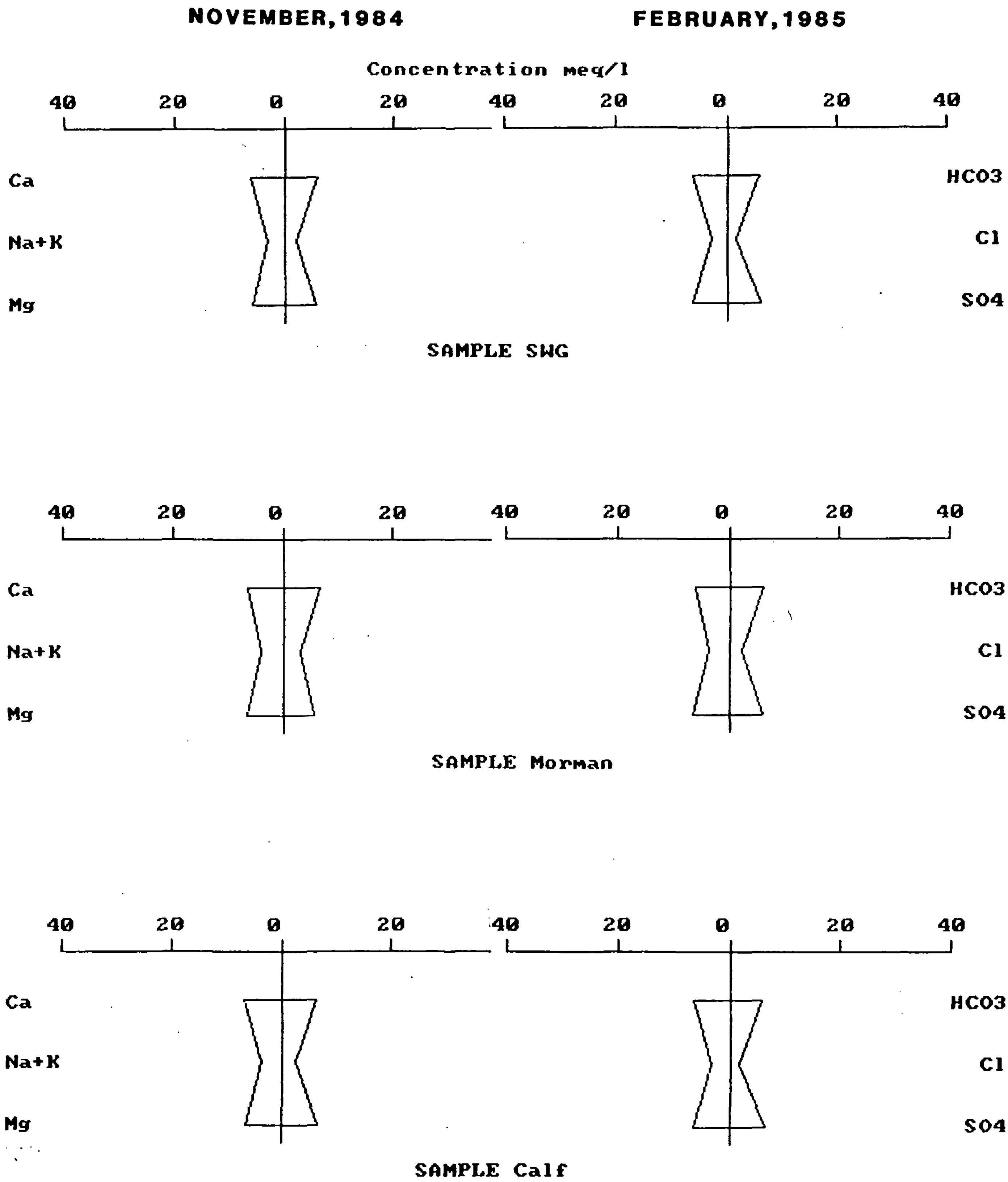
STIFF DIAGRAMS FOR WELLS SWG, MORMON AND CALF SPRINGS

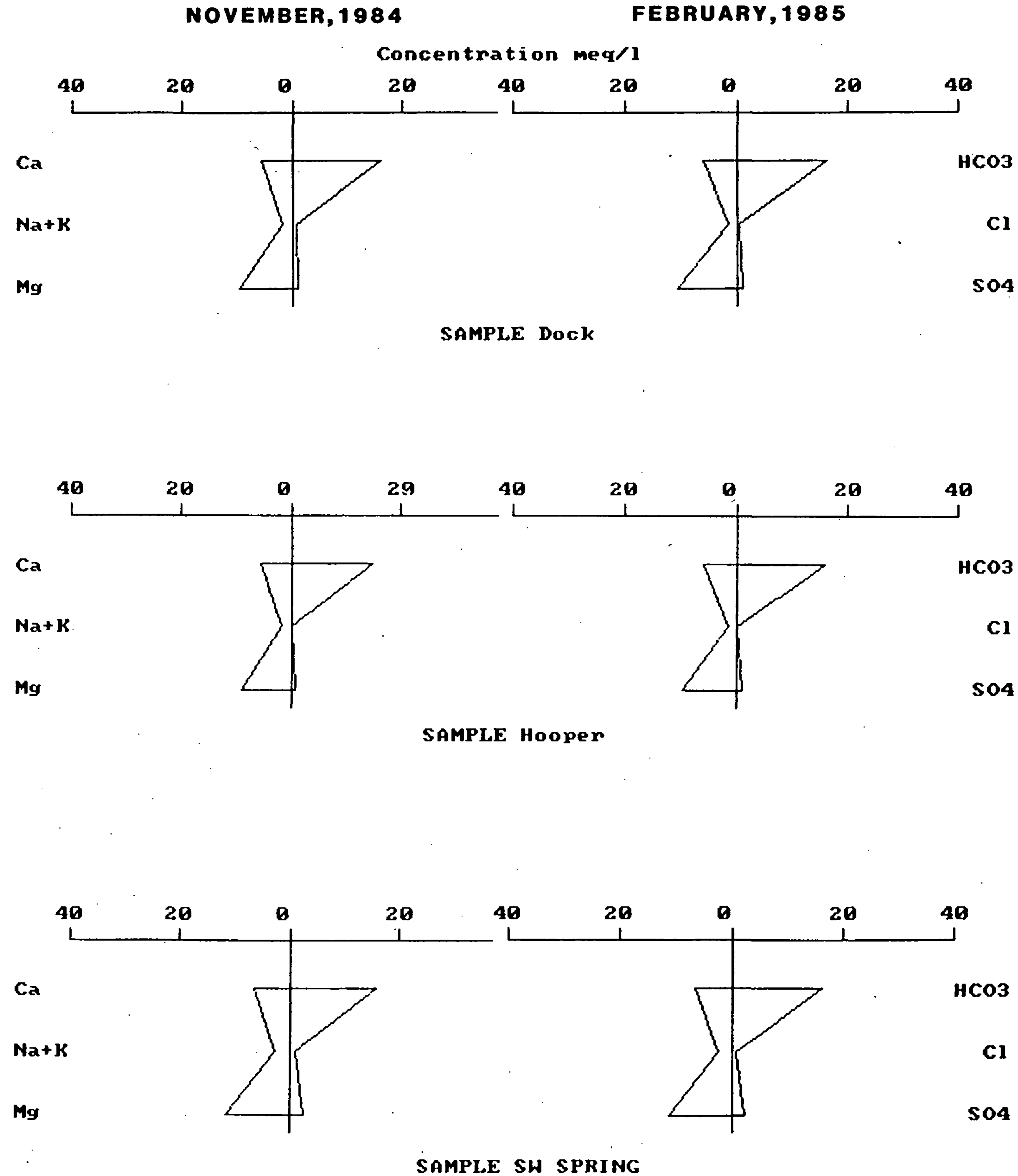
Figure B-18



PROJECT NO. DRAWN REVIEWED DATE

STIFF DIAGRAMS FOR DOCK, HOOPER AND SW SPRING

Figure B-19



PROJECT NO. DRAWN REVIEWED DATE

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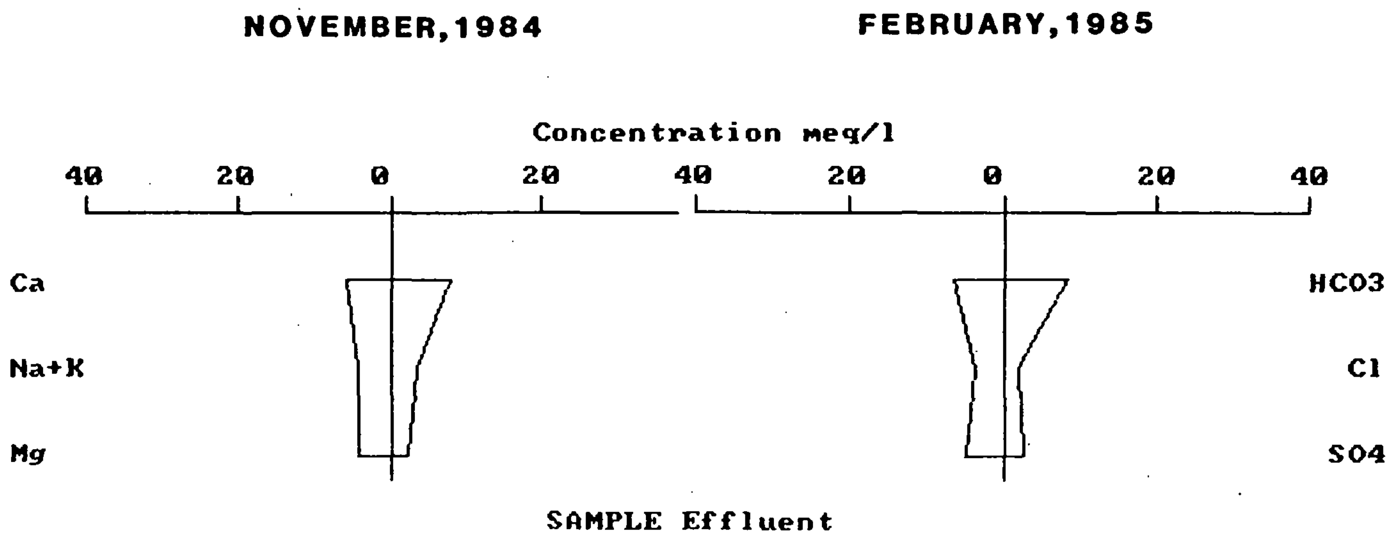
STIFF DIAGRAM FOR EFFLUENT

Figure B-20

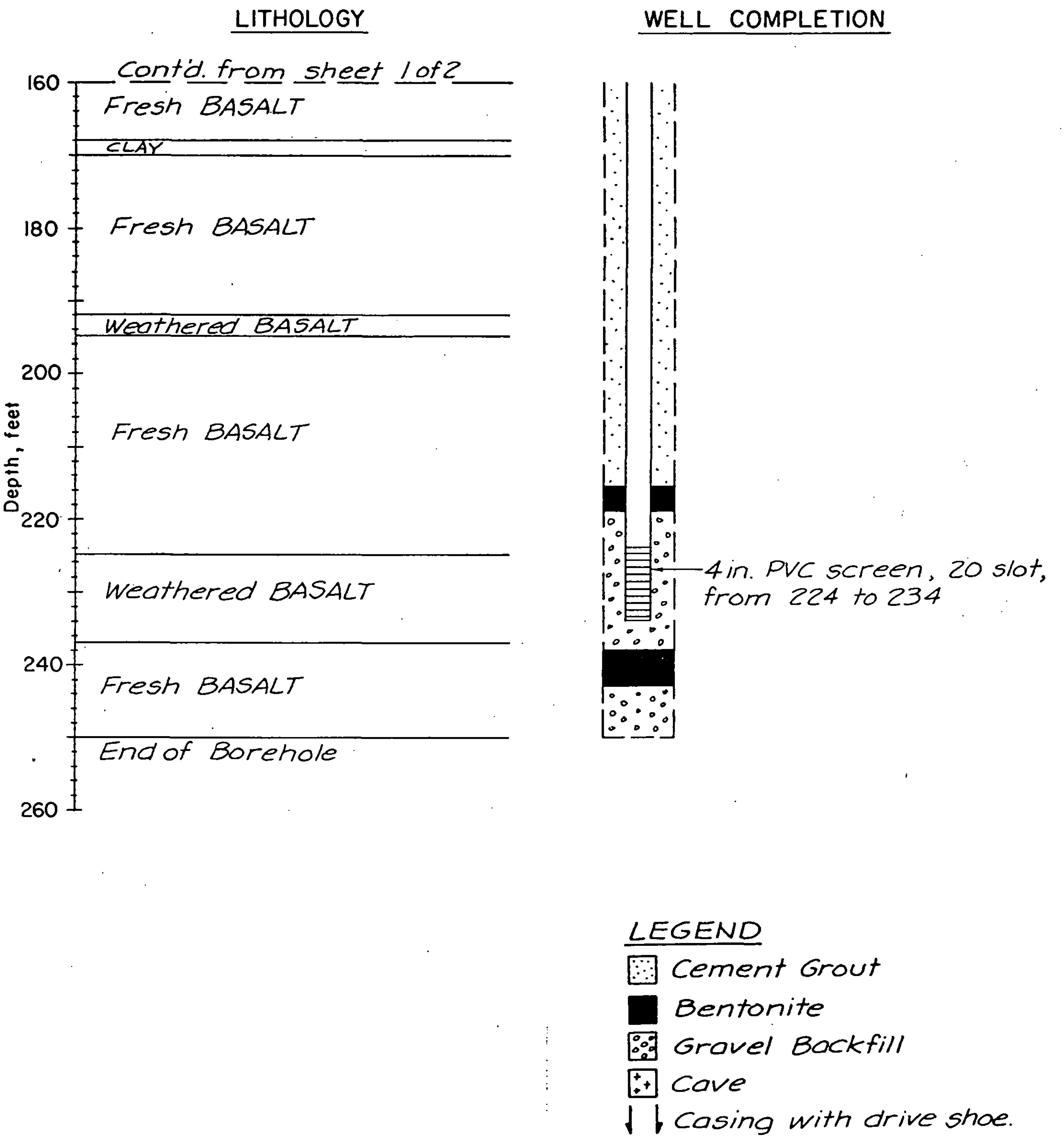


PROJECT NO. DRAWN REVIEWED DATE

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 18

Figure A-19

Sheet 2 of 2



Scale 1 in. to 20 ft.

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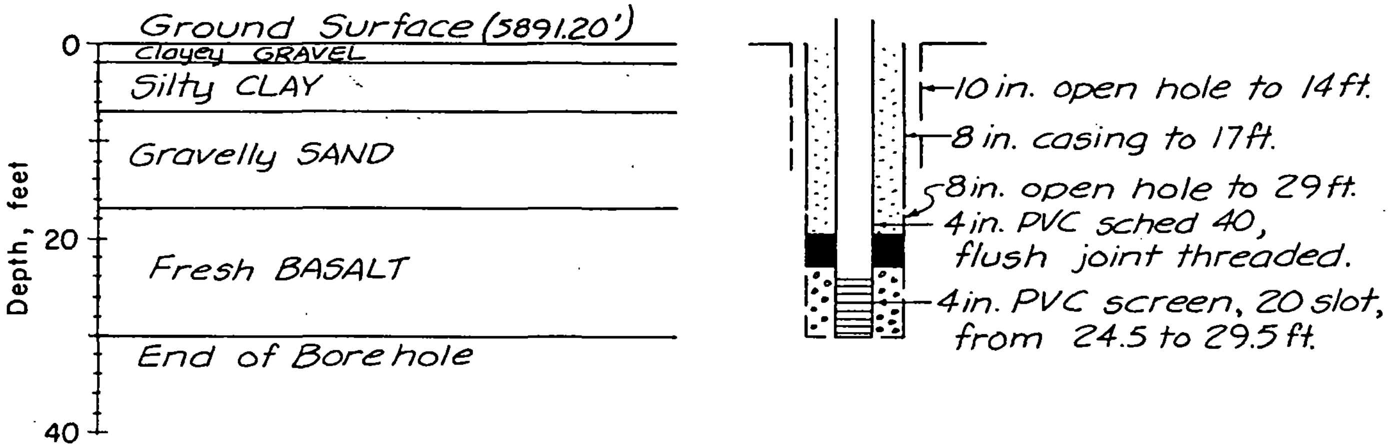
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 19

Figure A-19

LITHOLOGY — WELL COMPLETION



LEGEND

- Cement Grout
- Bentonite
- Gravel Backfill
- Cave
- Casing with drive shoe.

Scale 1 in. to 20 ft.

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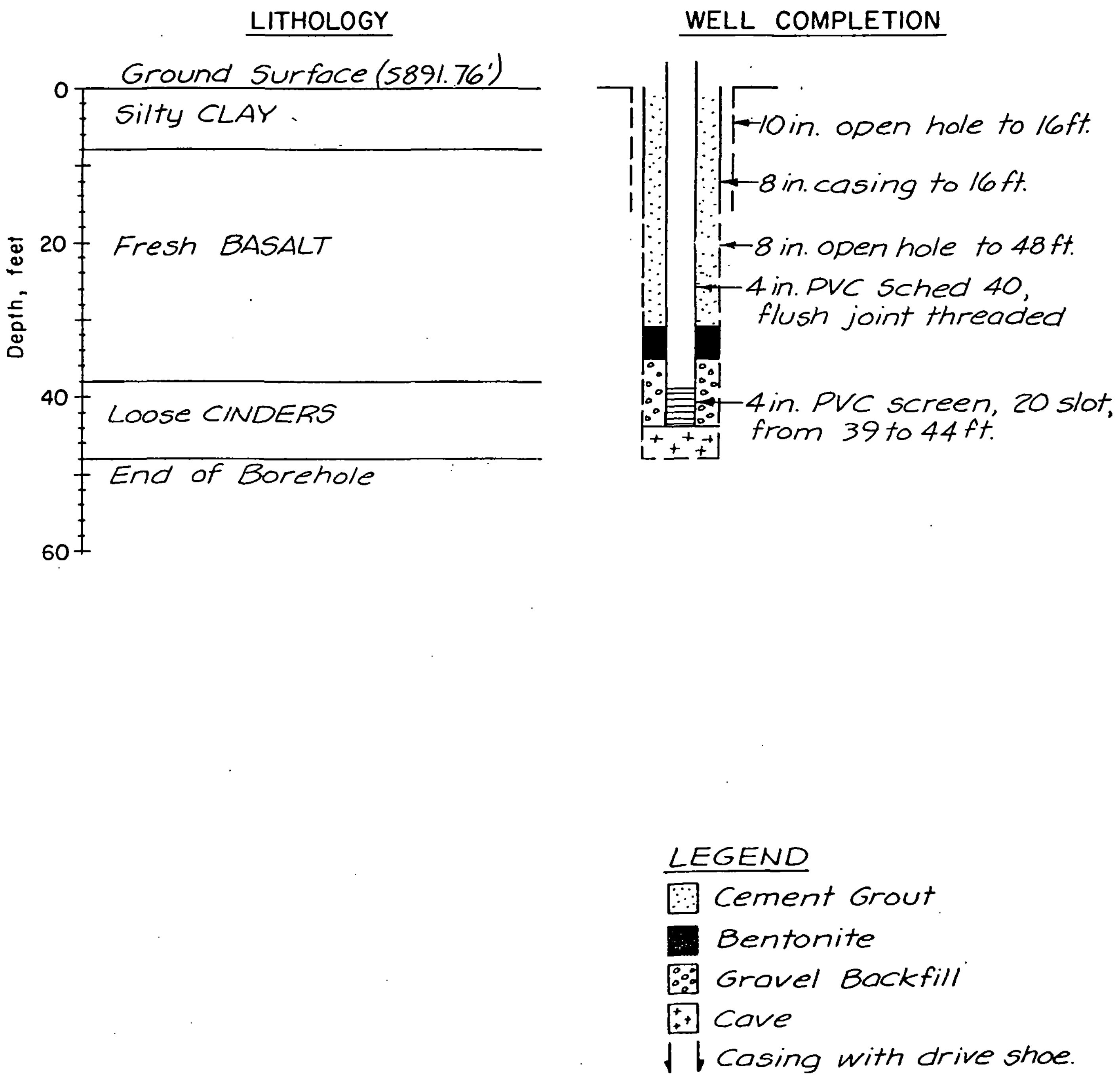
PROJECT NO. 842-1543 DRAWN ...... REVIEWED ...... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 20

Figure **A-20**



Scale 1 in. to 20 ft.

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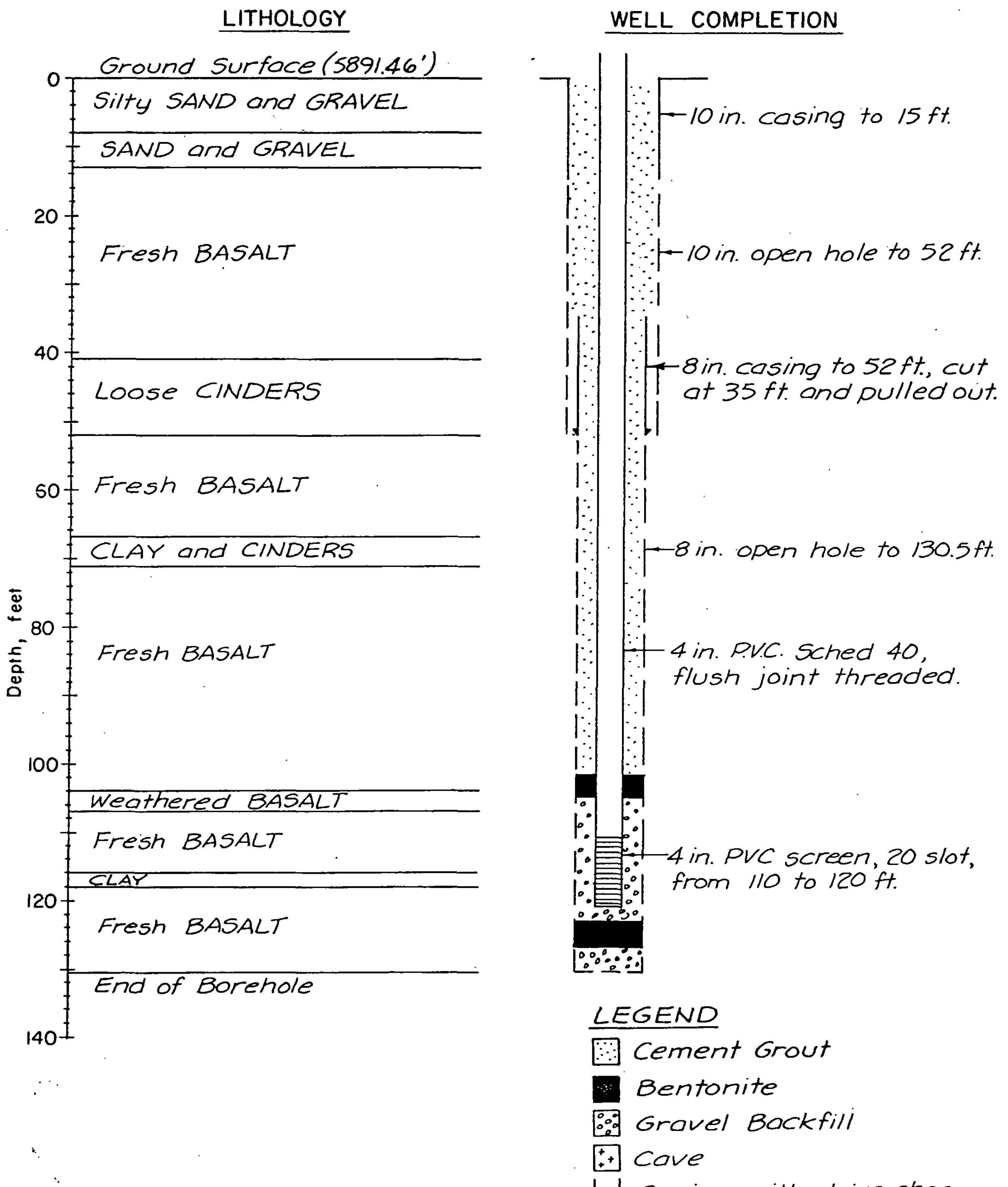
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 21

Figure A-21

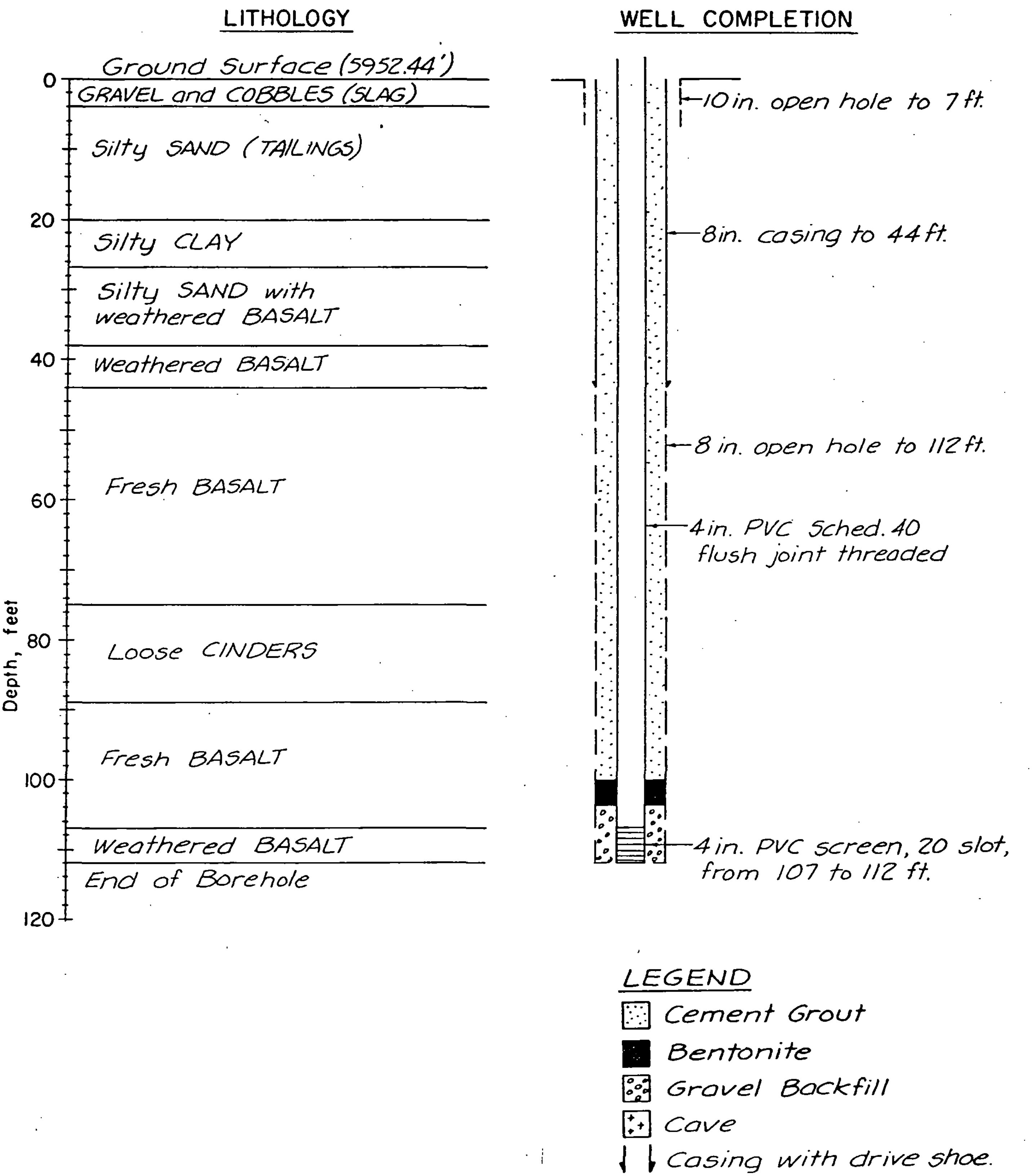


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION MONSANTO TW 22

Figure A-22



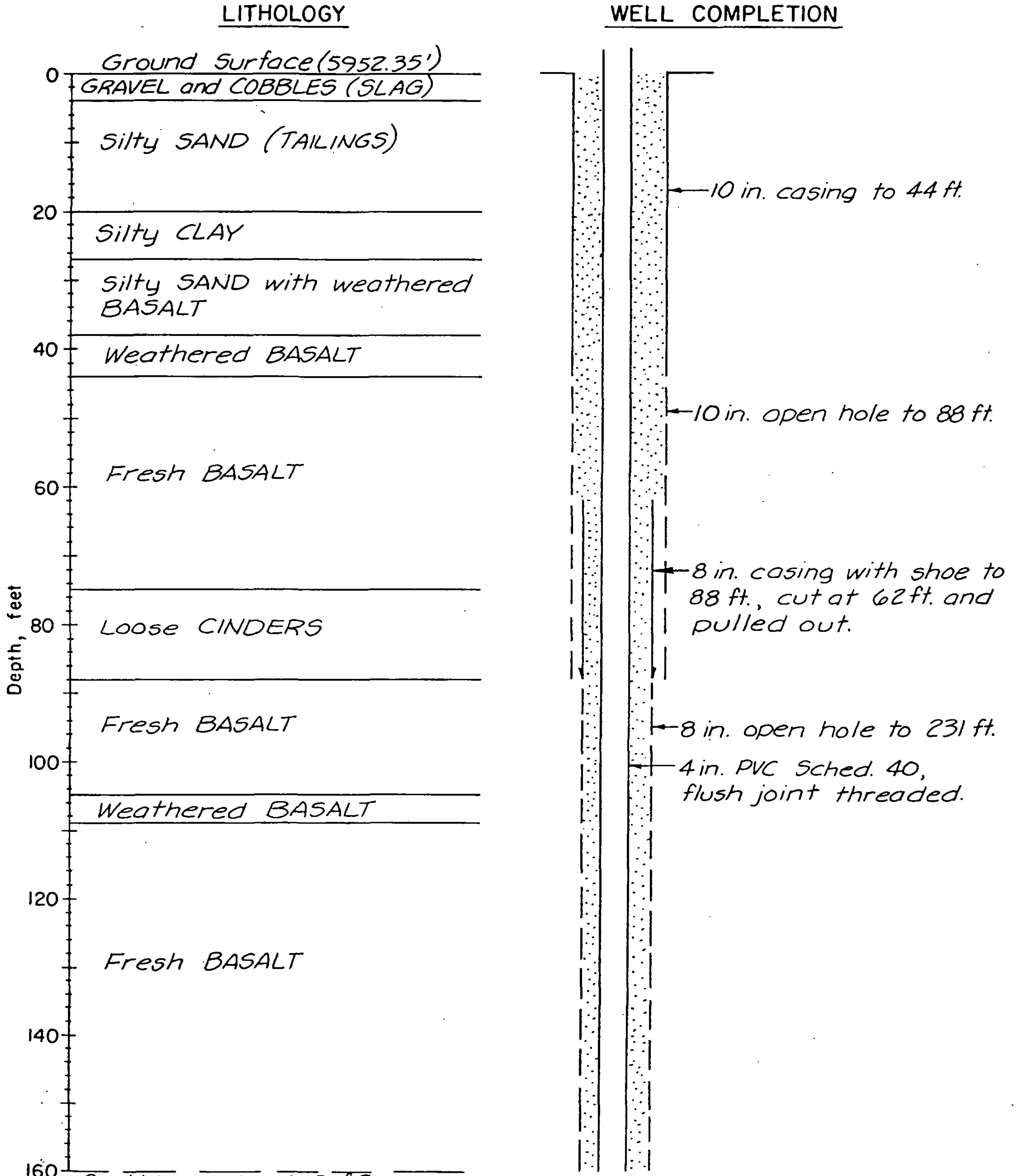
Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 23

Figure A-23

Sheet 1 of 2



Cont'd on sheet 2 of 2

Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

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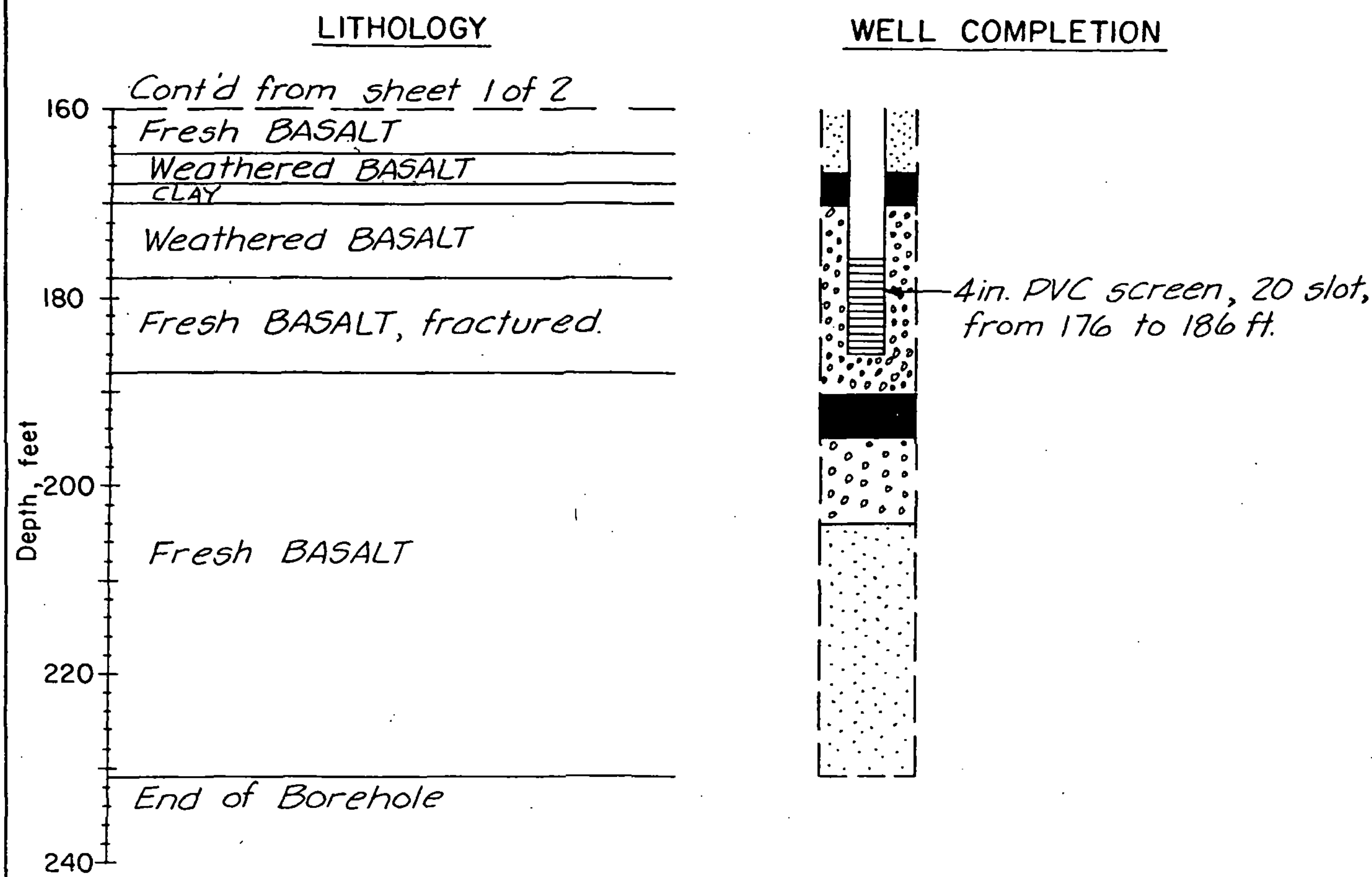
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 23

Figure



LEGEND

- Cement Grout
- Bentonite
- Gravel Backfill
- Cave
- Casing with drive shoe.

Scale 1 in. to 20 ft.

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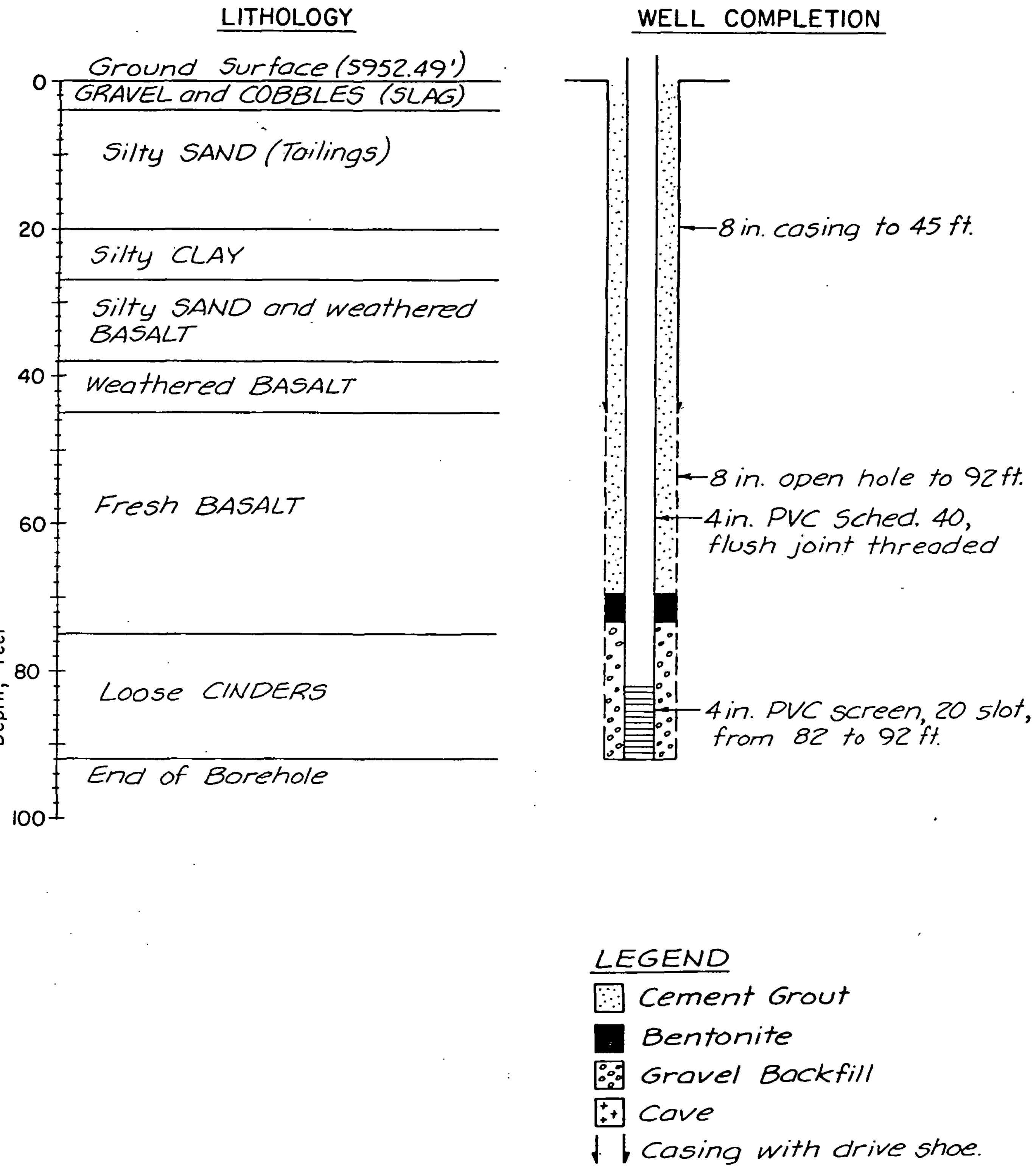
PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 24

Figure A-24



Scale 1 in. to 20 ft.

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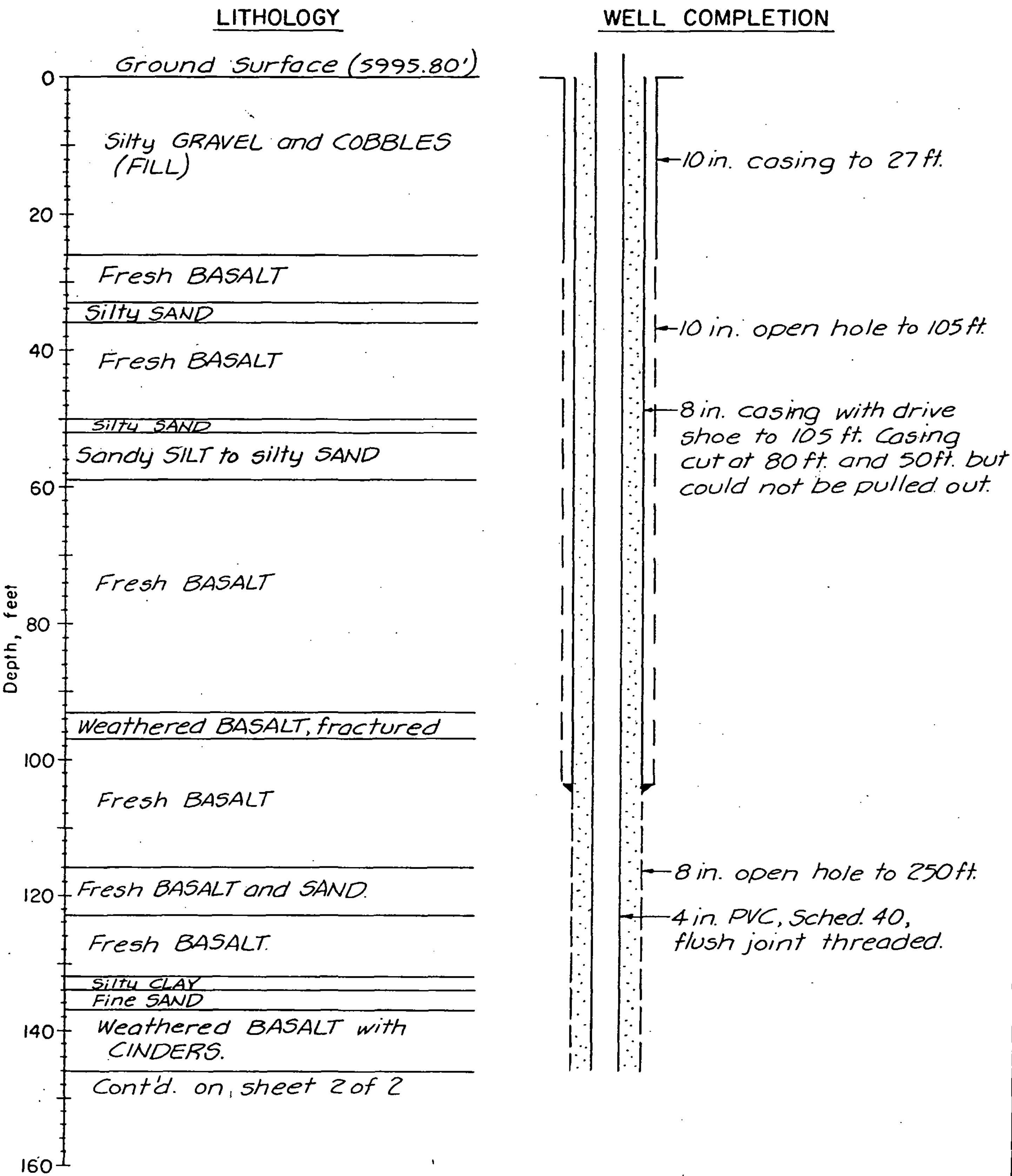
PROJECT NO. 842-1543 DRAWN ...... REVIEWED ...... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 25

Figure A-25

Sheet 1 of 2



Scale 1 in. to 20 ft.

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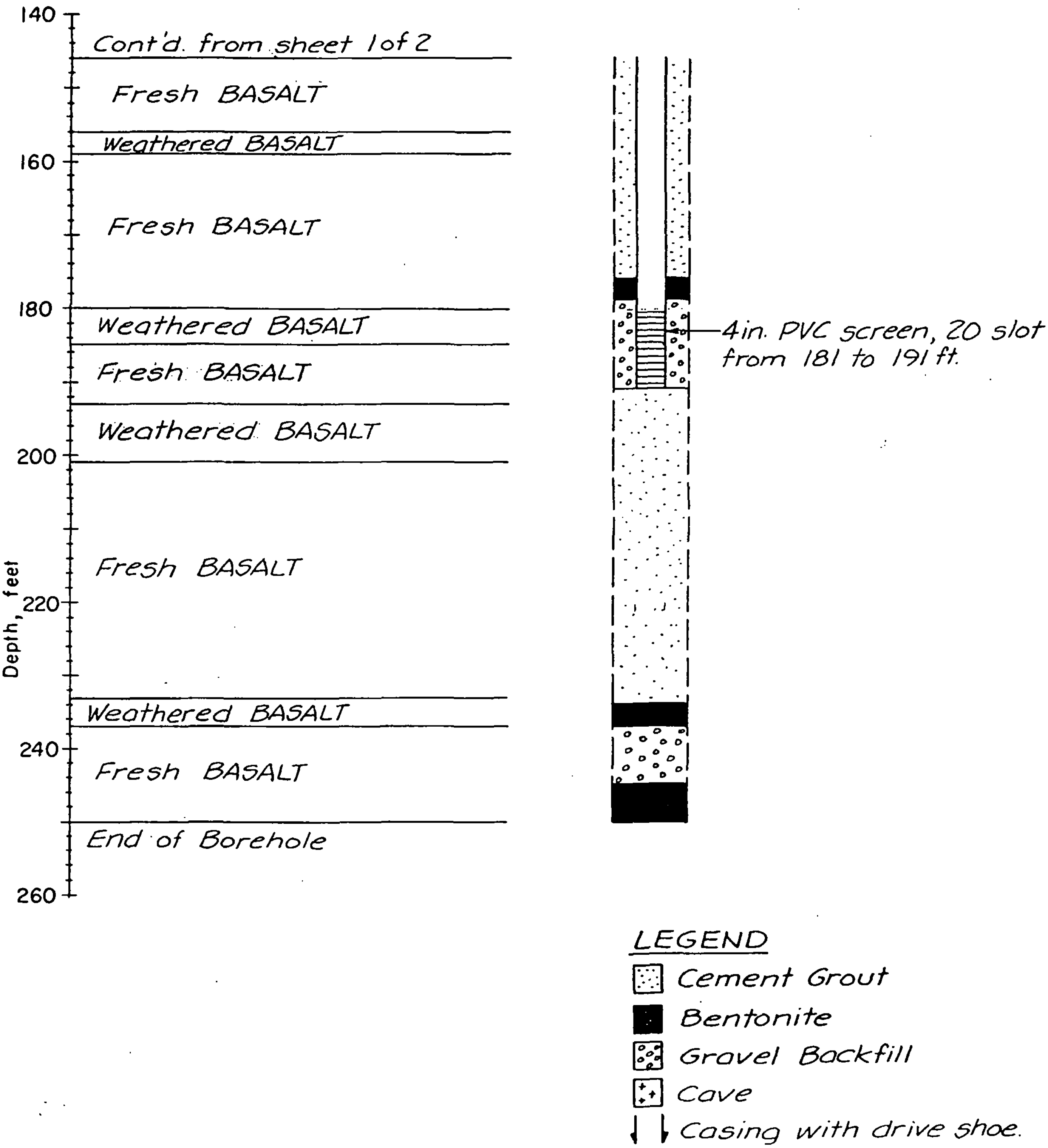
PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 25

Figure

Sheet 2 of 2

LITHOLOGY | WELL COMPLETION



Scale 1 in. to 20 ft.

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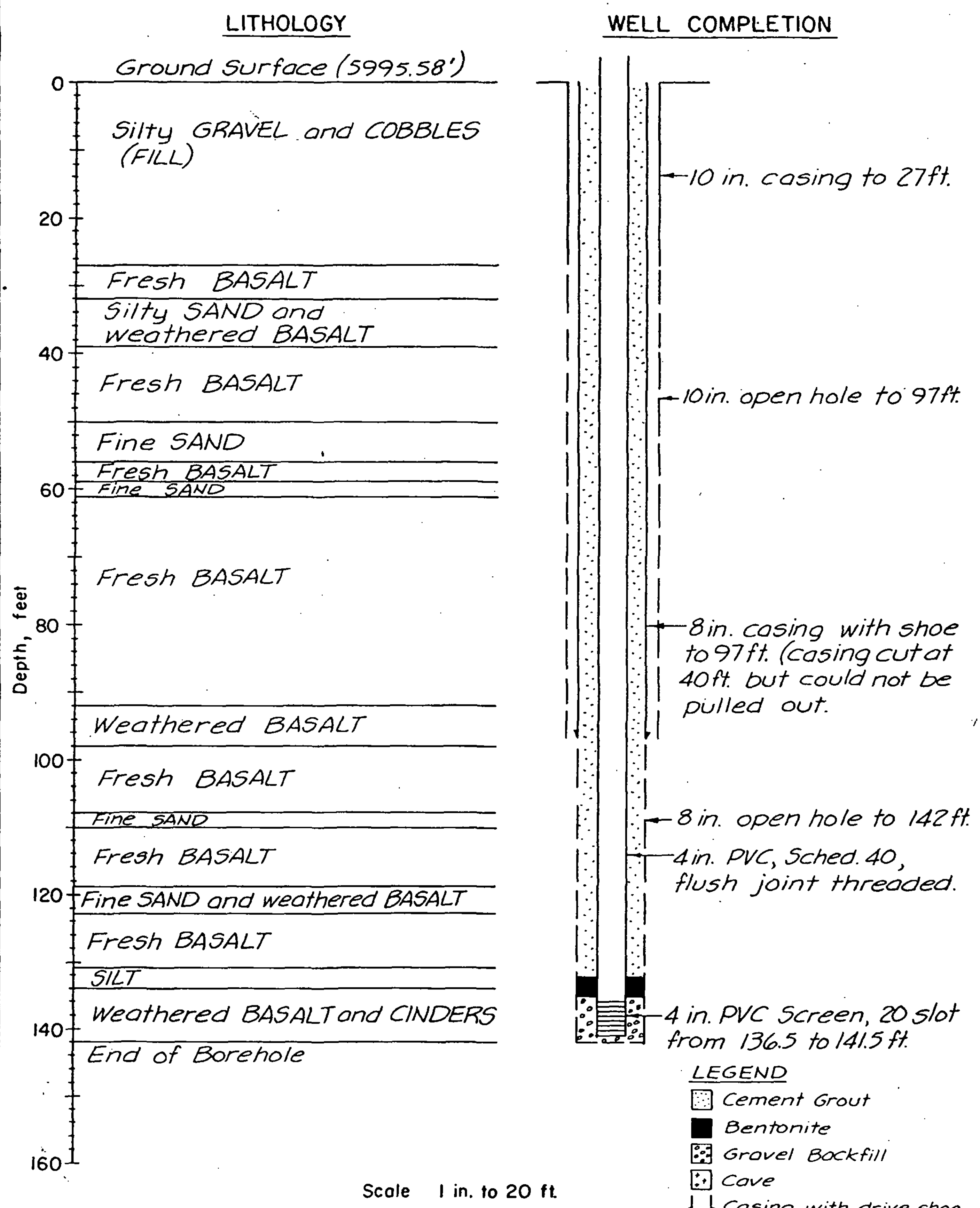
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 26

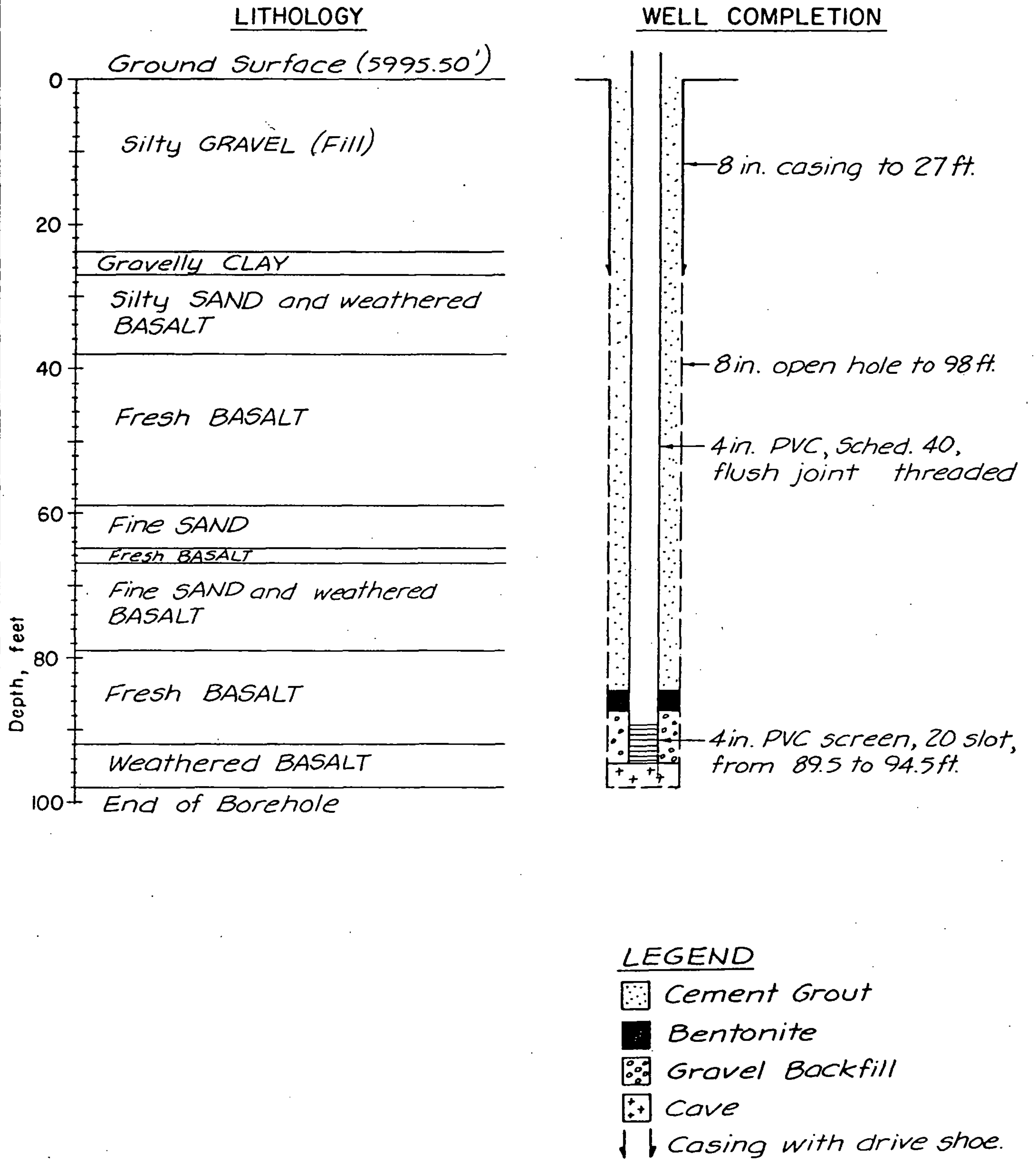
Figure A-26



PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 27

Figure A-27

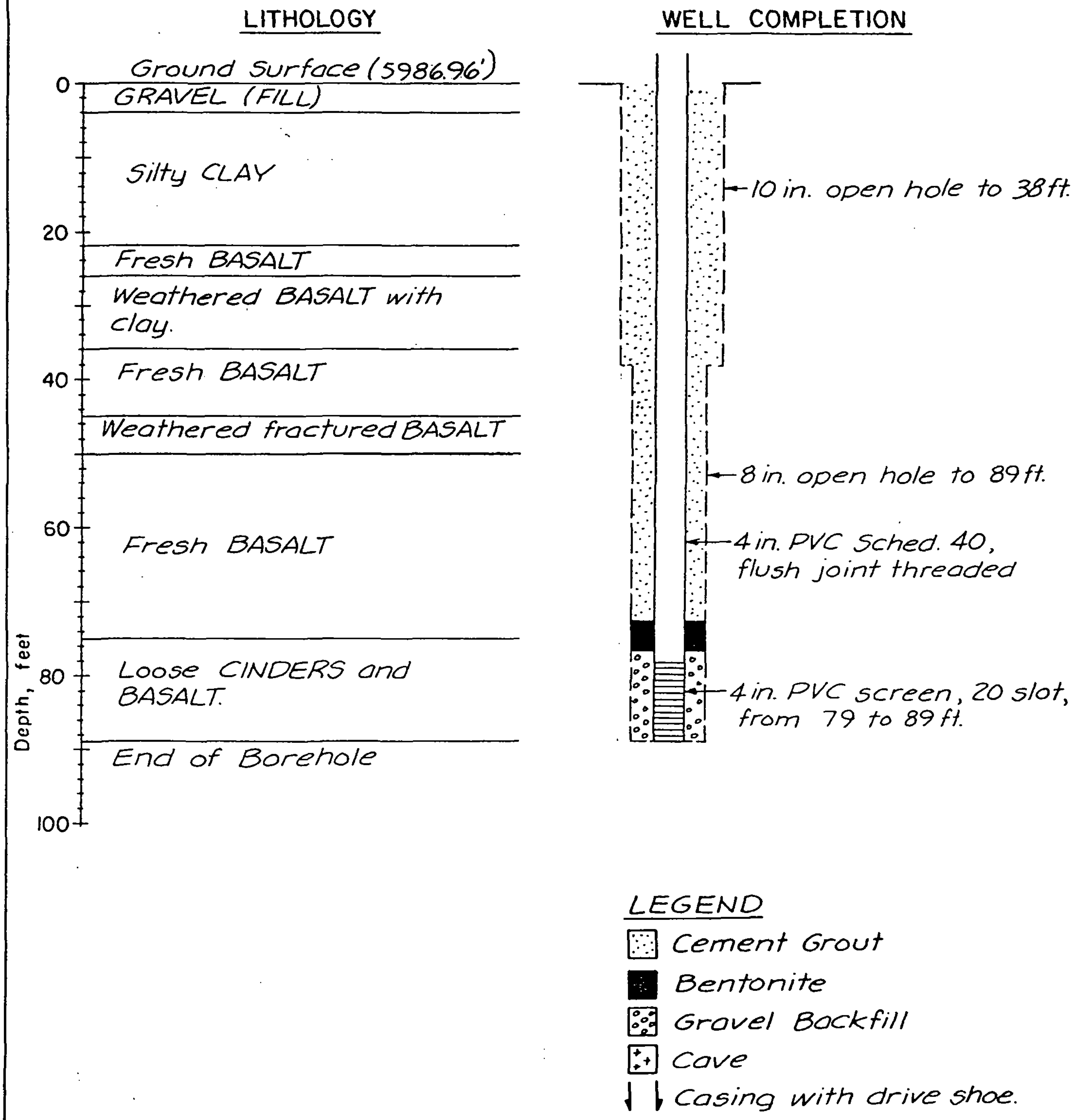


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 28

Figure A-28



Scale 1 in. to 20 ft.

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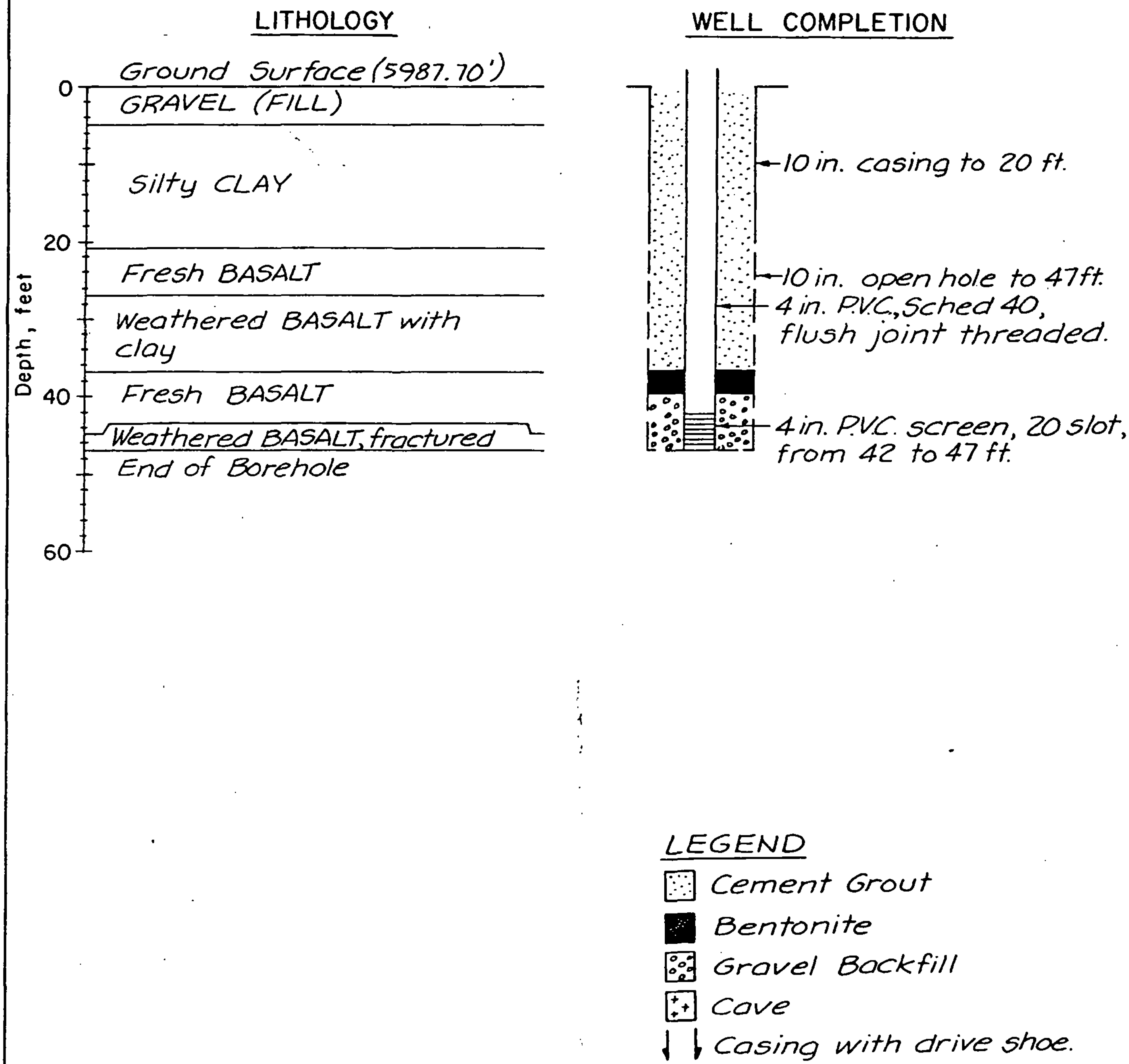
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 29

Figure A-29

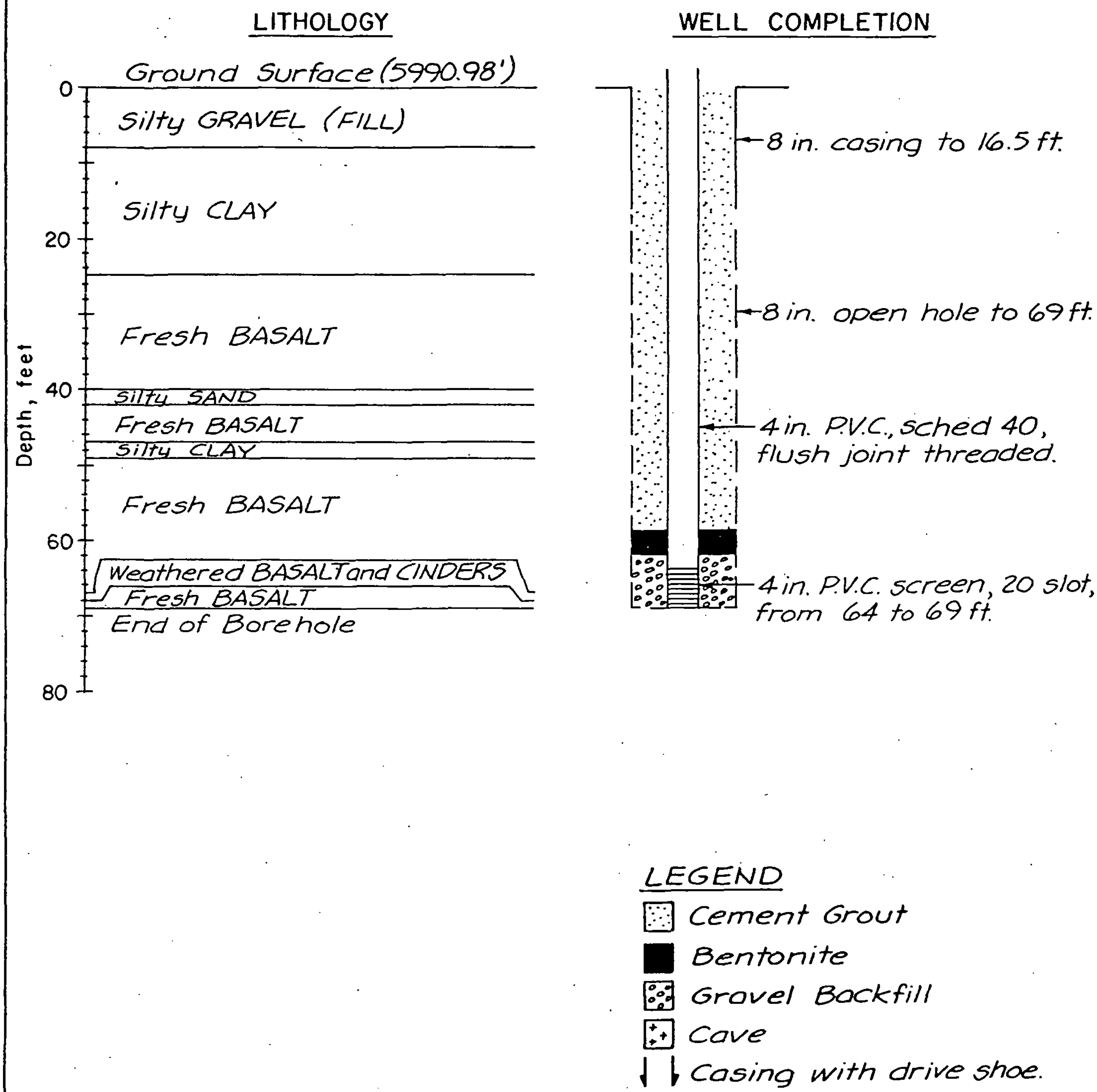


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 30

Figure A-30



Scale 1 in. to 20 ft.

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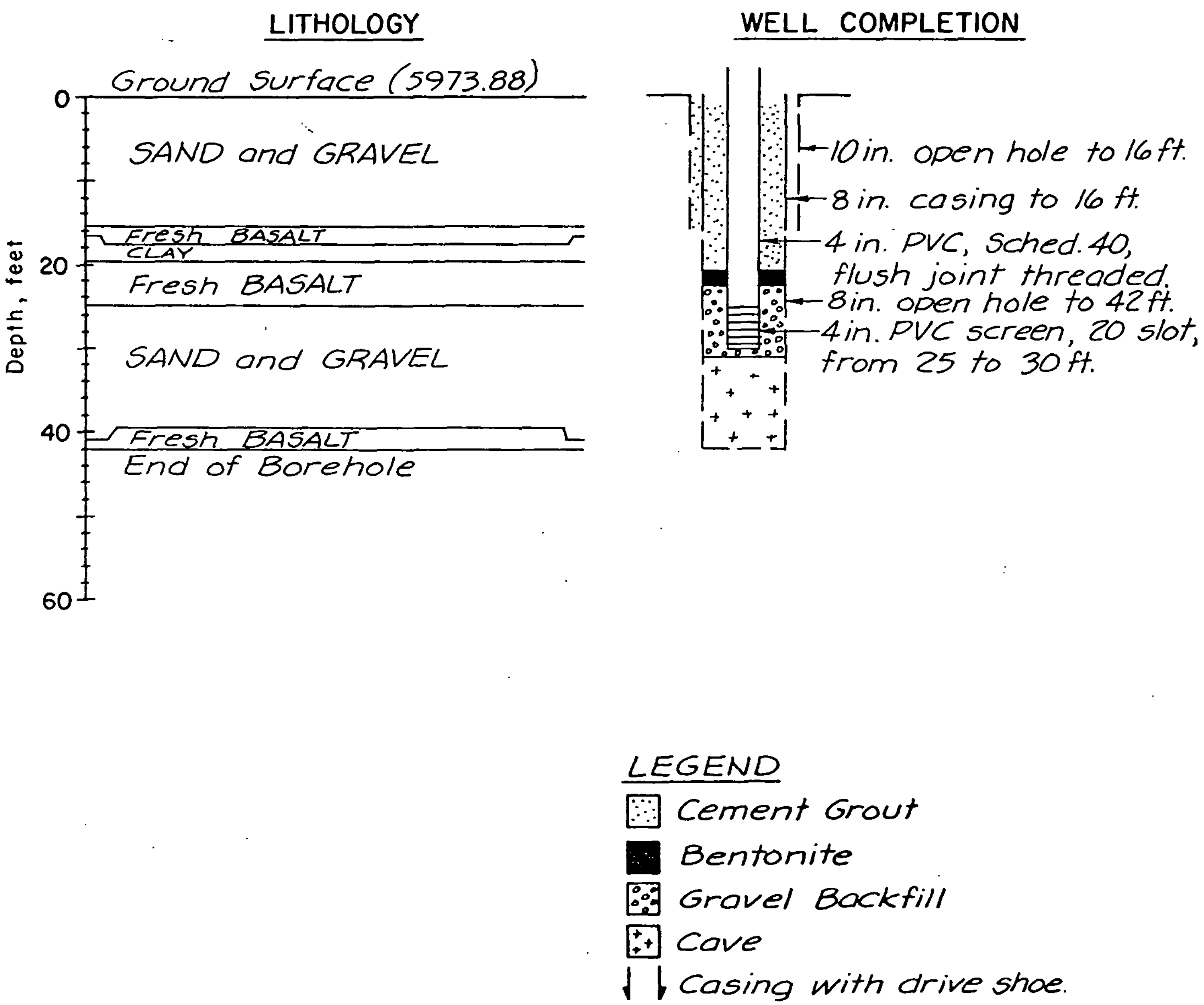
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 31

Figure A-31



Scale 1 in. to 20 ft.

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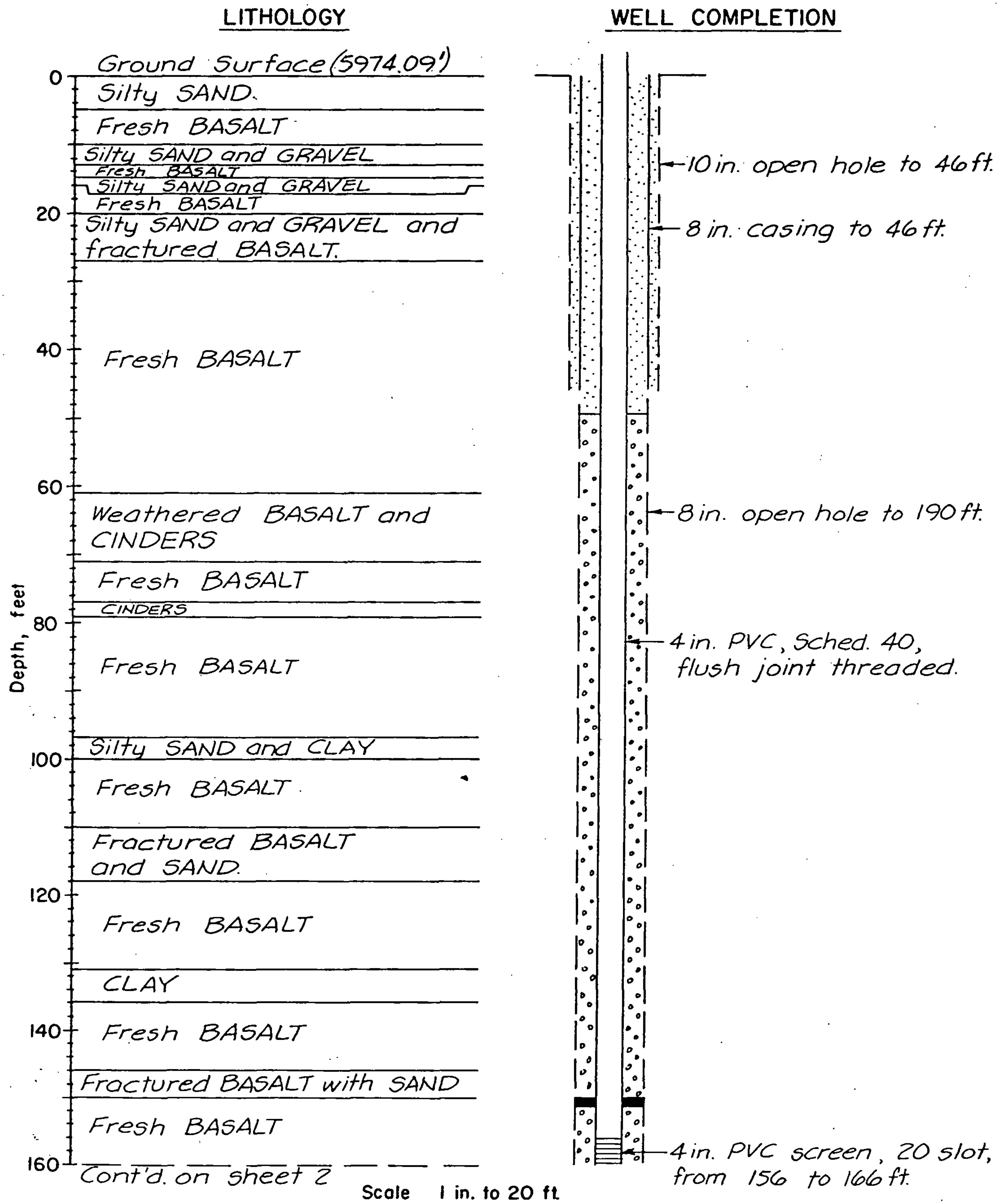
LITHOLOGY AND WELL COMPLETION MONSANTO TW 32	Figure A-32



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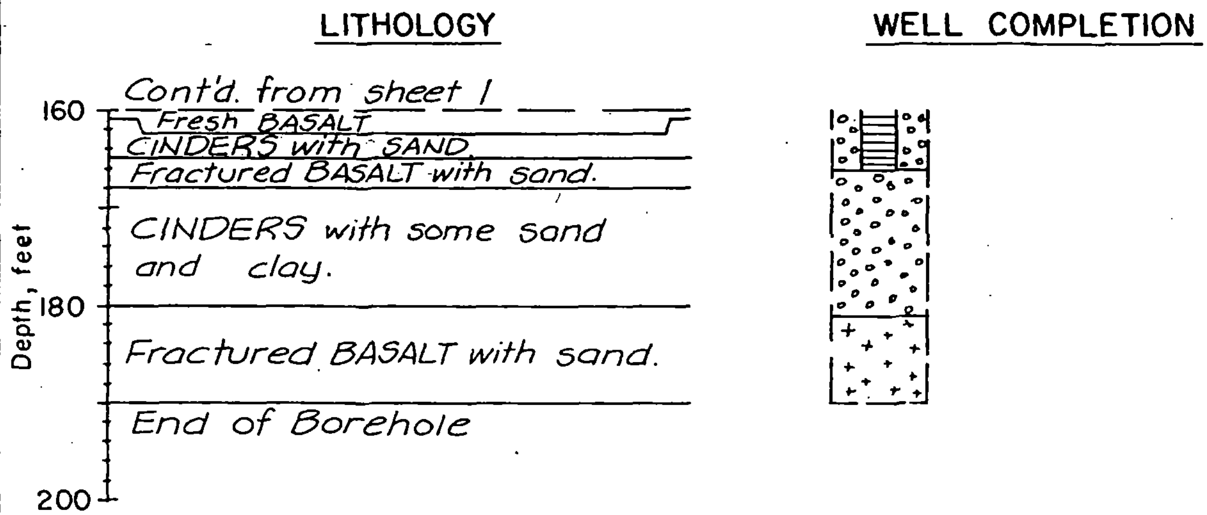
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 32

Figure



LEGEND

- Cement Grout
- Bentonite
- Gravel Backfill
- Cave
- Casing with drive shoe.

Scale 1 in. to 20 ft.

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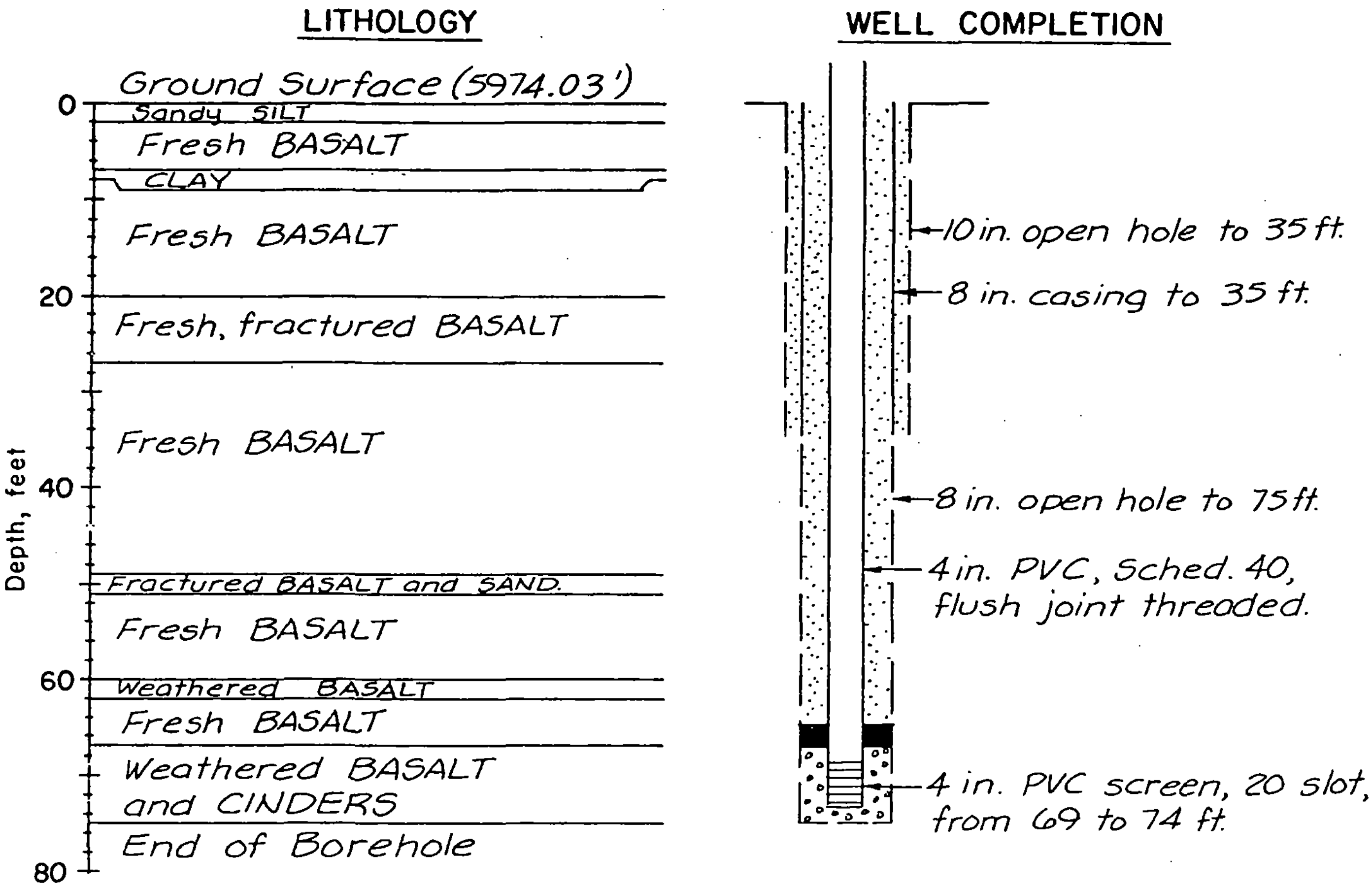
PROJECT NO. 842-1543 DRAWN REVIEWED DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 33

Figure A-33



LEGEND

- Cement Grout
- Bentonite
- Gravel Backfill
- Cave
- Casing with drive shoe.

Scale 1 in. to 20 ft

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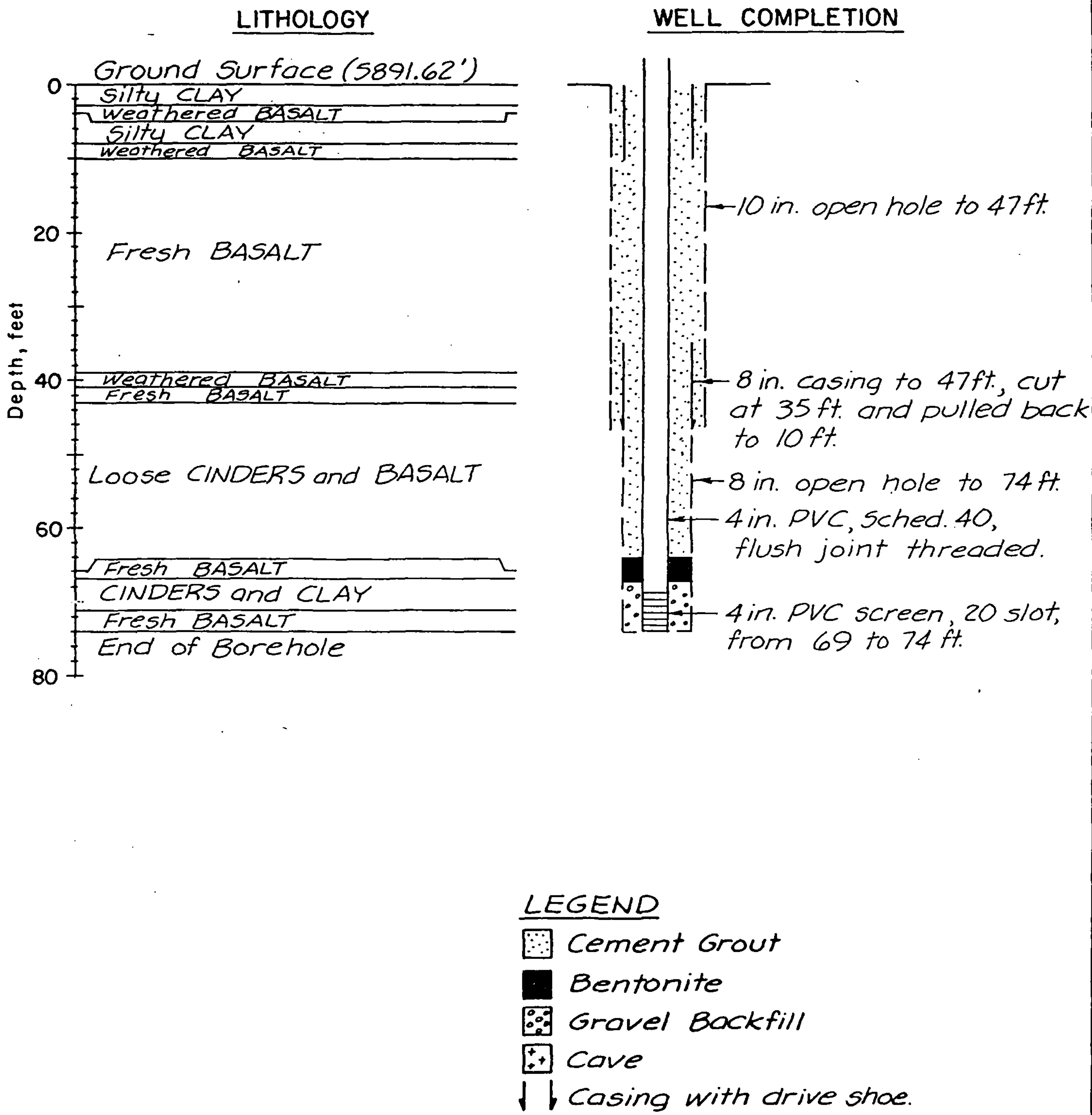
PROJECT NO. 842-1543 DRAWN .... REVIEWED .... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 34

Figure **A-34**

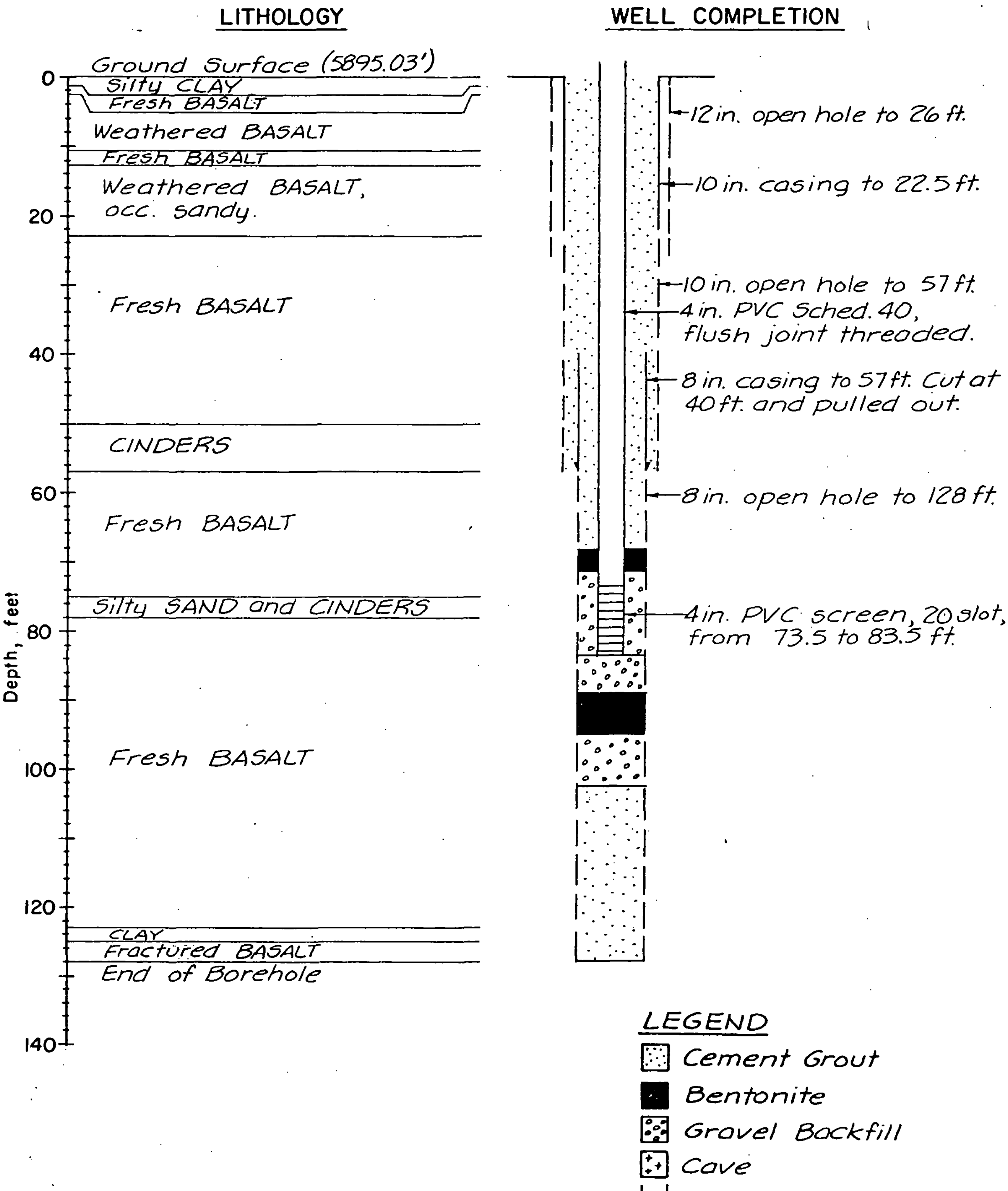


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN ...... REVIEWED ...... DATE Dec. '84

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 35

Figure A-35

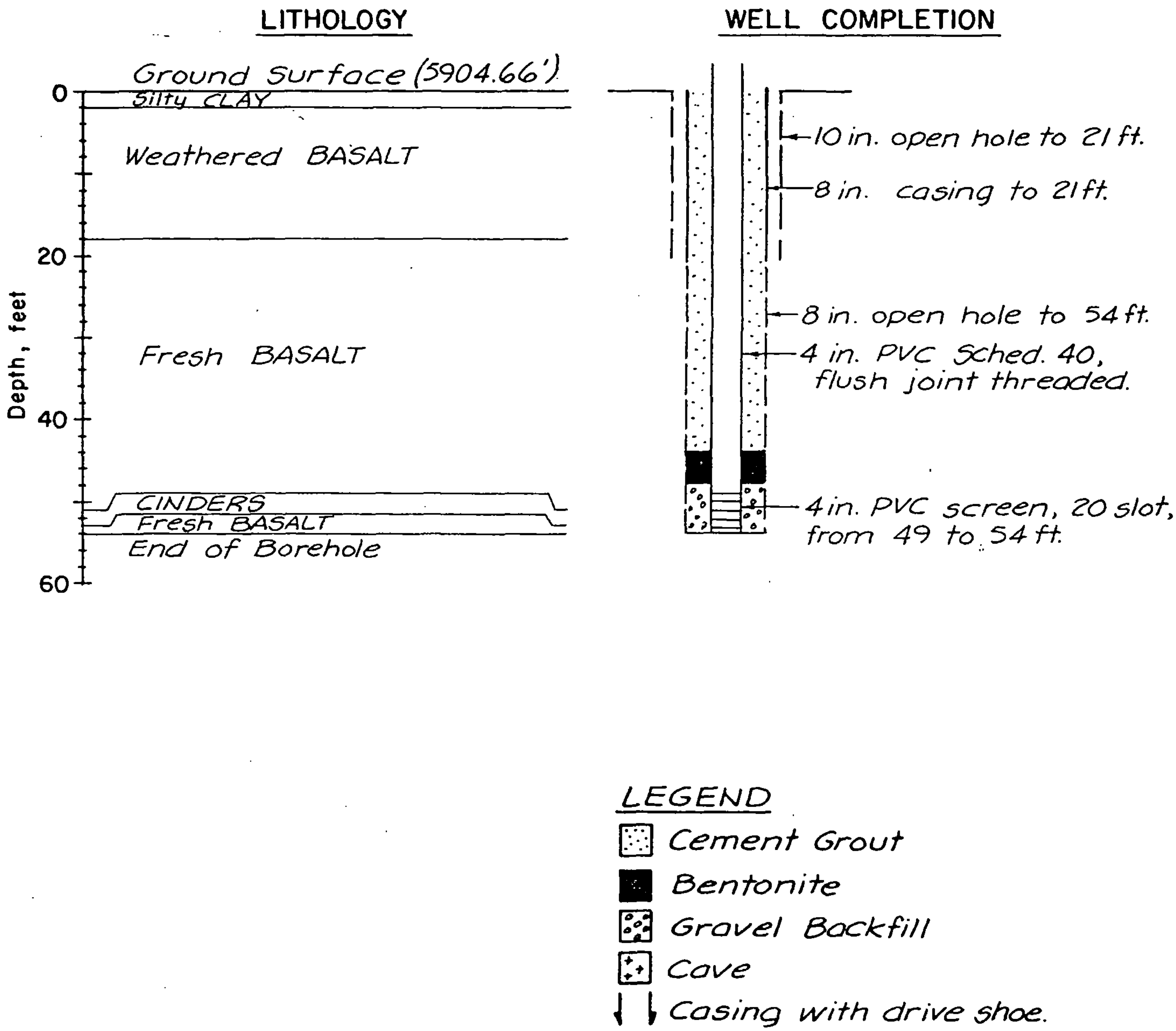


Scale 1 in. to 20 ft.

PROJECT NO. 842-1543 DRAWN REVIEWED DATE

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 36

Figure A-36



Scale 1 in. to 20 ft.

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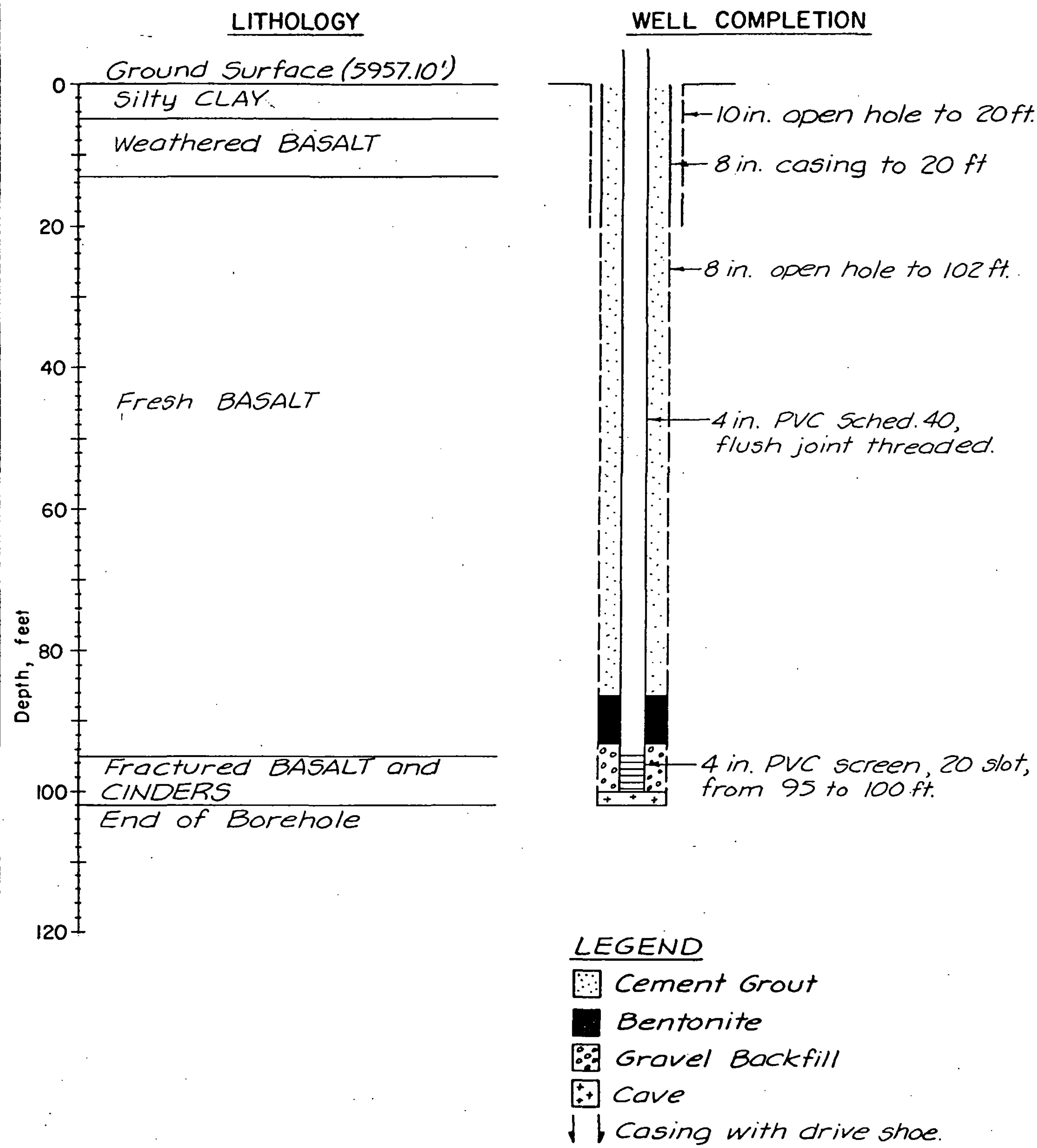
PROJECT NO 842-1543 DRAWN REVIEWED DATE

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 37

Figure **A-37**



Scale 1 in. to 20 ft

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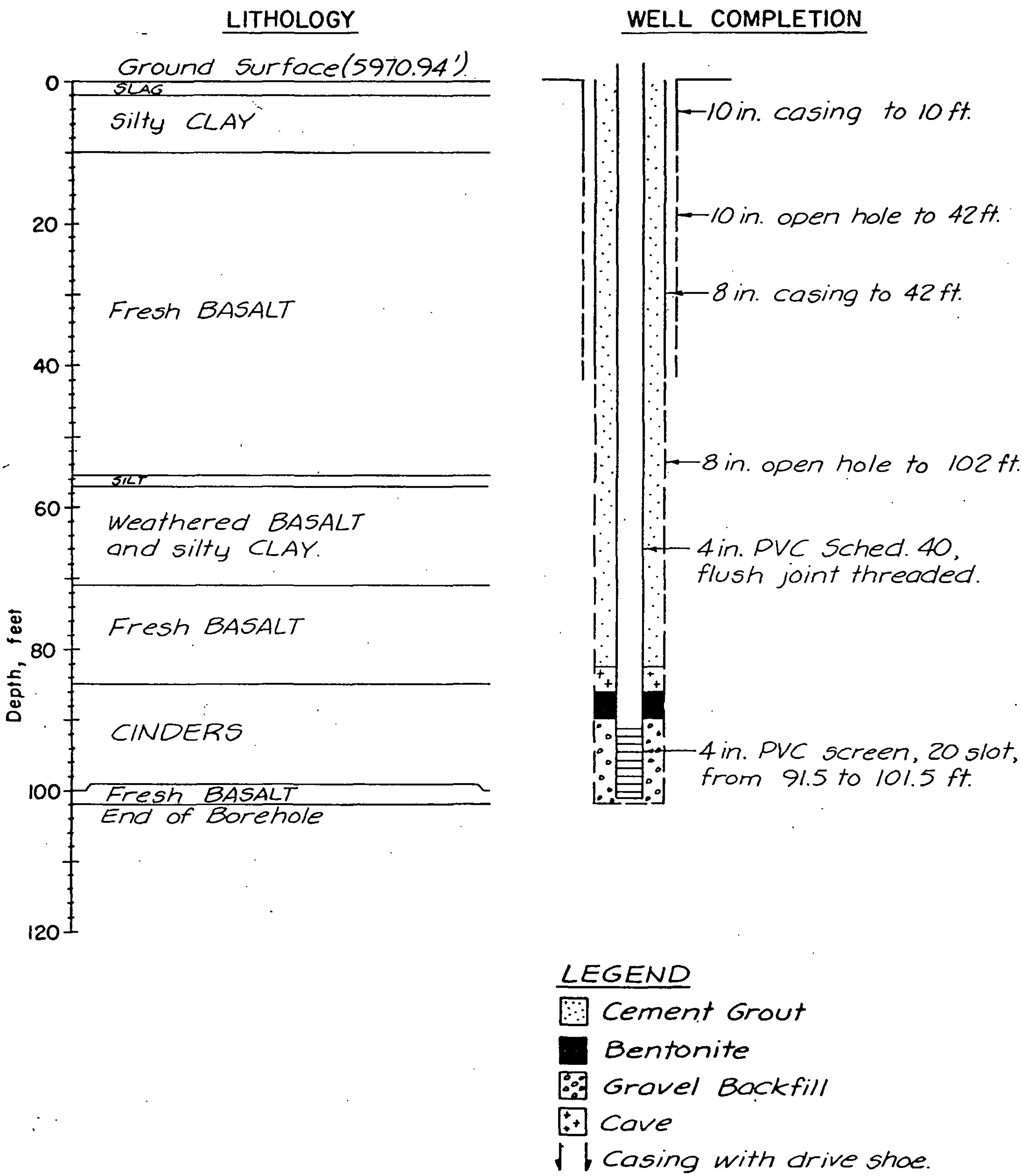
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 38

Figure A-38



Scale 1 in. to 20 ft

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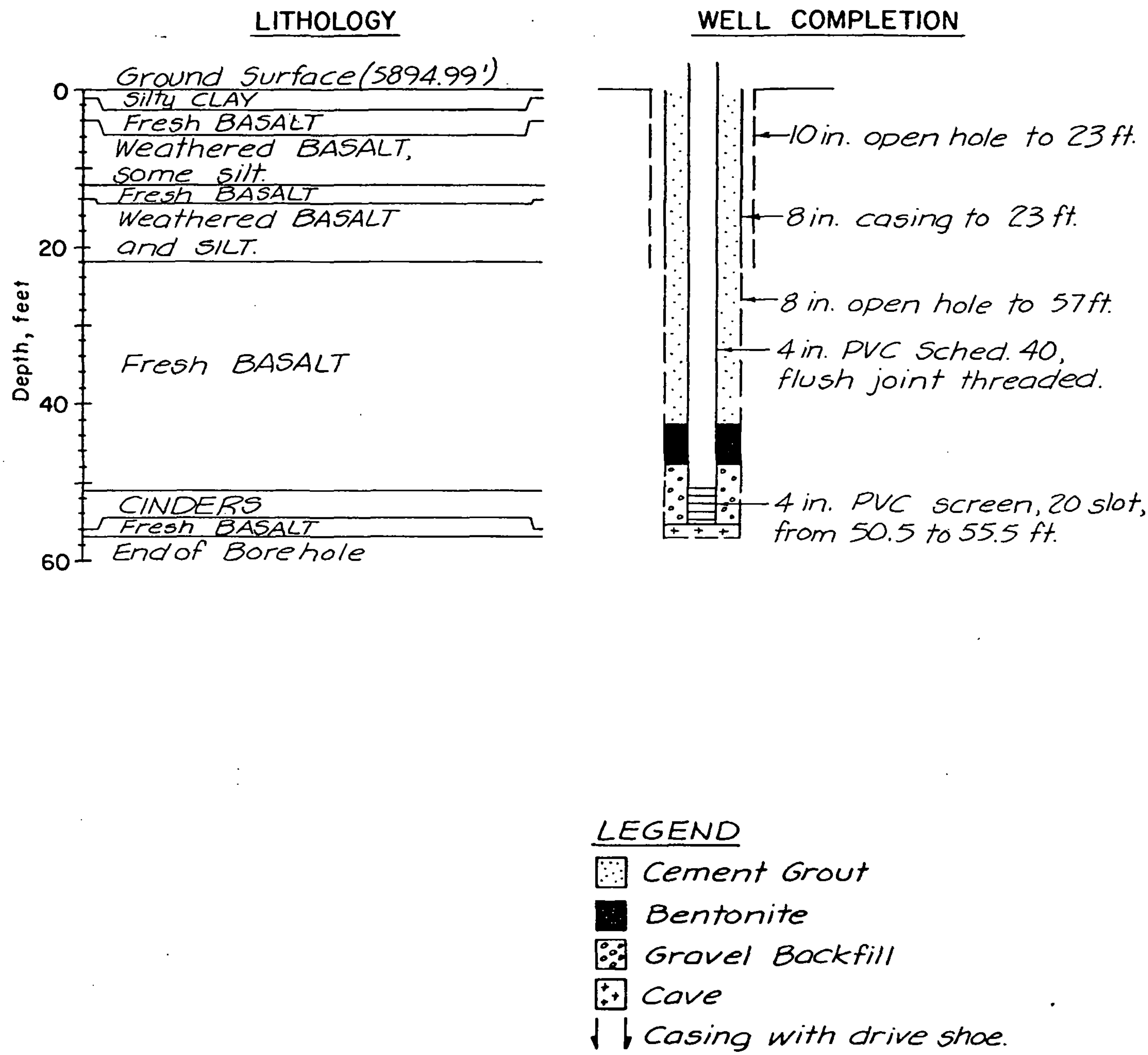
LITHOLOGY AND WELL COMPLETION
MONSANTO TW 39

Figure A-39



Scale 1 in. to 20 ft.

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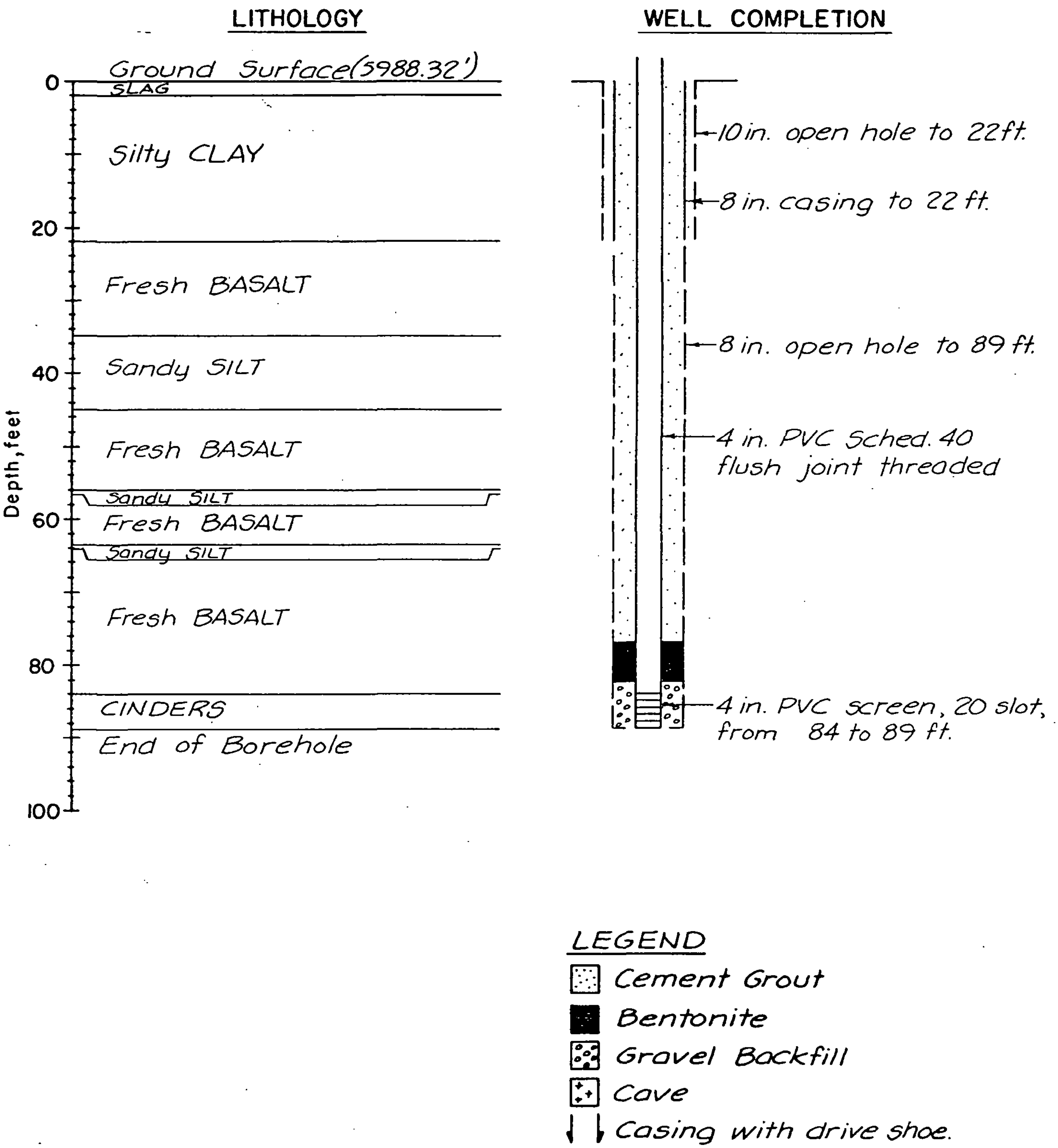
PROJECT NO. 842-1543 DRAWN REVIEWED DATE

LITHOLOGY AND WELL COMPLETION
MONSANTO TW 40

Figure A-40



Scale 1 in. to 20 ft.

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PROJECT NO. 842-1543 DRAWN REVIEWED DATE

Appendix B

Water Quality Analysis and Stiff Diagrams

NOTES FOR CHEMICAL ANALYSES

pH	-	referenced to standard units
Eh	-	in millivolts referenced to silver-silver chloride electrode
mg/l	-	milligrams per liter
meg/l	-	milliequivalents per liter
	-	alkalinity is expressed with reference to milligrams per liter of calcium carbonate (mg/l of $CaCo_3$)

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	PW1
Laboratory Number:	76001
Date Sampled:	11-13-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.65
Eh (millivolts)	110
Conductivity (micromhos/cm)	1090

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	1570
Total Alkalinity (mg of CaCO3/l)	444
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1040
Sodium Adsorption Ratio	1.6
Total Hardness (mg of CaCO3/l)	640
Ionic Strength	2.55E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		2.26E-04	2.24E-04	
Calcium (Ca)		136	6.79E+00	3.39E-03
Magnesium (Mg)		73	6.00E+00	3.00E-03
Sodium (Na)		93	4.05E+00	4.05E-03
Potassium (K)		24	6.14E-01	6.14E-04
Arsenic (As)		0.007		9.34E-08
Cadmium (Cd)		0.192	3.42E-03	1.71E-06
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.08		1.57E-06
Zinc (Zn)		0.18	5.51E-03	2.75E-06
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		327	1.75E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	541	8.87E+00	8.87E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	141	3.98E+00	3.98E-03
Fluoride (F)	1.73	9.11E-02	9.11E-05
Nitrate + Nitrite (NOX)	45.9	8.50E-01	8.50E-04
Sulfate (SO4)	166	3.46E+00	1.73E-03
Dissolved Silica (H4SiO4)	72.5		7.54E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	968	1.72E+01	

Dissolved Solid Ratio	1.25
Cation-Anion Balance	0.72%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	PW2
Laboratory Number:	76002
Date Sampled:	11-13-84

Field Measurements	
Temperature(C)	12
pH (standard units)	6.72
Eh (millivolts)	130
Conductivity (micromhos/cm)	780

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	1130
Total Alkalinity (mg of CaCO3/l)	425
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	782
Sodium Adsorption Ratio	0.70
Total Hardness (mg of CaCO3/l)	548
Ionic Strength	1.94E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.92E-04	1.91E-04	
Calcium (Ca)		124	6.19E+00	3.09E-03
Magnesium (Mg)		58	4.77E+00	2.39E-03
Sodium (Na)		38	1.65E+00	1.65E-03
Potassium (K)		12	3.07E-01	3.07E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.05		9.82E-07
Zinc (Zn)		0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		233	1.30E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	518	8.49E+00	8.49E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	58	1.64E+00	1.64E-03
Fluoride (F)	0.69	3.63E-02	3.63E-05
Nitrate + Nitrite (NOX)	40.5	7.50E-01	7.50E-04
Sulfate (SO4)	95	1.98E+00	9.89E-04
Dissolved Silica (H4SiO4)	59.9		6.23E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	772	1.29E+01	

Dissolved Solid Ratio	1.29
Cation-Anion Balance	0.25%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	PW3
Laboratory Number:	76003
Date Sampled:	11-13-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.78
Eh (millivolts)	140
Conductivity (micromhos/cm)	750

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	1080
Total Alkalinity (mg of CaCO3/l)	429
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	756
Sodium Adsorption Ratio	0.61
Total Hardness (mg of CaCO3/l)	518
Ionic Strength	1.82E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.67E-04	1.66E-04	
Calcium (Ca)		115	5.74E+00	2.87E-03
Magnesium (Mg)		56	4.61E+00	2.30E-03
Sodium (Na)		32	1.39E+00	1.39E-03
Potassium (K)		9	2.30E-01	2.30E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.06		1.18E-06
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		213	1.20E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	523	8.57E+00	8.57E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	45	1.27E+00	1.27E-03
Fluoride (F)	0.55	2.89E-02	2.89E-05
Nitrate + Nitrite (NOX)	39	7.22E-01	7.22E-04
Sulfate (SO4)	84	1.75E+00	8.74E-04
Dissolved Silica (H4SiO4)	55.1		5.73E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	747	1.23E+01	

Dissolved Solid Ratio	1.27
Cation-Anion Balance	1.38%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW2
Laboratory Number:	76006
Date Sampled:	11-13-84

Field Measurements

Temperature(C)	10
pH (standard units)	6.71
Eh (millivolts)	160
Conductivity (micromhos/cm)	675

Laboratory Measurements

pH (standard units)	7.0
Conductivity (micromhos/cm)	982
Total Alkalinity (mg of CaCO3/l)	464
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	712
Sodium Adsorption Ratio	0.32
Total Hardness (mg of CaCO3/l)	538
Ionic Strength	1.77E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.97E-04	1.95E-04	
Calcium (Ca)	120	5.99E+00	2.99E-03
Magnesium (Mg)	58	4.77E+00	2.39E-03
Sodium (Na)	17	7.39E-01	7.39E-04
Potassium (K)	5	1.28E-01	1.28E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.06		1.18E-06
Zinc (Zn)	0.29	8.87E-03	4.44E-06
Ammonium (NH4)	< 0.6	3.33E-02	3.33E-05
Total	201	1.17E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	566	9.27E+00	9.27E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	22	6.21E-01	6.21E-04
Fluoride (F)	0.22	1.16E-02	1.16E-05
Nitrate + Nitrite (NOX)	4.70	8.70E-02	8.70E-05
Sulfate (SO4)	74	1.54E+00	7.70E-04
Dissolved Silica (H4SiO4)	54.8		5.70E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	721	1.15E+01	

Dissolved Solid Ratio	1.30
Cation-Anion Balance	0.61%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW3
Laboratory Number:	75934
Date Sampled:	11-10-84

Field Measurements	
Temperature(C)	11
pH (standard units)	5.82
Eh (millivolts)	58
Conductivity (micromhos/cm)	1030

Laboratory Measurements	
pH (standard units)	6.3
Conductivity (micromhos/cm)	1600
Total Alkalinity (mg of CaCO3/l)	970
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1160
Sodium Adsorption Ratio	0.51
Total Hardness (mg of CaCO3/l)	1013
Ionic Strength	3.44E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.53E-03	1.51E-03	
Calcium (Ca)		122	6.09E+00	3.04E-03
Magnesium (Mg)		172	1.41E+01	7.08E-03
Sodium (Na)		37	1.61E+00	1.61E-03
Potassium (K)		18	4.60E-01	4.60E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		9.03	4.04E-01	1.62E-04
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.32	1.16E-02	5.82E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)		0.03	9.18E-04	4.59E-07
Ammonium (NH4)		0.9	4.99E-02	4.99E-05
Total		359	2.28E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1182	1.94E+01	1.94E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		28	7.90E-01	7.90E-04
Fluoride (F)		0.3	1.58E-02	1.58E-05
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)		122	2.54E+00	1.27E-03
Dissolved Silica (H4SiO4)		139.6		1.45E-03
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		1473	2.27E+01	

Dissolved Solid Ratio	1.58
Cation-Anion Balance	0.10%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW4
Laboratory Number:	75935
Date Sampled:	11-10-84

Field Measurements	
Temperature(C)	7
pH (standard units)	5.80
Eh (millivolts)	30
Conductivity (micromhos/cm)	1180

Laboratory Measurements	
pH (standard units)	6.2
Conductivity (micromhos/cm)	1860
Total Alkalinity (mg of CaCO3/l)	999
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1160
Sodium Adsorption Ratio	0.46
Total Hardness (mg of CaCO3/l)	1023
Ionic Strength	3.52E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.60E-03	1.58E-03	
Calcium (Ca)		128	6.39E+00	3.19E-03
Magnesium (Mg)		171	1.41E+01	7.03E-03
Sodium (Na)		34	1.48E+00	1.48E-03
Potassium (K)		17	4.35E-01	4.35E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		14.2	6.36E-01	2.54E-04
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.6	2.18E-02	1.09E-05
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)		0.11	3.37E-03	1.68E-06
Ammonium (NH4)		5.4	2.99E-01	2.99E-04
Total		370	2.33E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1218	2.00E+01	2.00E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		26	7.33E-01	7.33E-04
Fluoride (F)		0.4	2.11E-02	2.11E-05
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)		125	2.60E+00	1.30E-03
Dissolved Silica (H4SiO4)		141.3		1.47E-03
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		1511	2.33E+01	

Dissolved Solid Ratio	1.62
Cation-Anion Balance	0.02%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW5
Laboratory Number:	75936
Date Sampled:	11-09-84
Field Measurements	
Temperature(C)	12
pH (standard units)	6.65
Eh (millivolts)	94
Conductivity (micromhos/cm)	1920
Laboratory Measurements	
pH (standard units)	6.8
Conductivity (micromhos/cm)	2820
Total Alkalinity (mg of CaCO3/l)	290
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	2000
Sodium Adsorption Ratio	2.78
Total Hardness (mg of CaCO3/l)	909
Ionic Strength	4.58E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	2.26E-04	2.24E-04	
Calcium (Ca)	173	8.63E+00	4.32E-03
Magnesium (Mg)	116	9.54E+00	4.77E-03
Sodium (Na)	193	8.39E+00	8.39E-03
Potassium (K)	144	3.68E+00	3.68E-03
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.211	3.75E-03	1.88E-06
Chromium (Cr)	0.11	4.23E-03	2.12E-06
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	3.43	1.25E-01	6.24E-05
Selenium (Se)	< 0.011		1.39E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.05		9.82E-07
Zinc (Zn)	1.33	4.07E-02	2.03E-05
Ammonium (NH4)	5.5	3.05E-01	3.05E-04
Total	637	3.07E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	354	5.79E+00	5.79E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	332	9.37E+00	9.37E-03
Fluoride (F)	10.7	5.63E-01	5.63E-04
Nitrate + Nitrite (NOX)	46.6	8.63E-01	8.63E-04
Sulfate (SO4)	632	1.32E+01	6.58E-03
Dissolved Silica (H4SiO4)	107.5		1.12E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1482	2.97E+01	

Dissolved Solid Ratio	1.06
Cation-Anion Balance	1.63%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW6
Laboratory Number:	75937
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	13
pH (standard units)	6.60
Eh (millivolts)	43
Conductivity (micromhos/cm)	2010

Laboratory Measurements	
pH (standard units)	6.9
Conductivity (micromhos/cm)	2900
Total Alkalinity (mg of CaCO3/l)	256
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	2050
Sodium Adsorption Ratio	2.72
Total Hardness (mg of CaCO3/l)	784
Ionic Strength	4.22E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	2.53E-04	2.51E-04	
Calcium (Ca)	156	7.78E+00	3.89E-03
Magnesium (Mg)	96	7.89E+00	3.95E-03
Sodium (Na)	175	7.61E+00	7.61E-03
Potassium (K)	149	3.81E+00	3.81E-03
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.47	8.36E-03	4.18E-06
Chromium (Cr)	0.128	4.92E-03	2.46E-06
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	3.73	1.36E-01	6.79E-05
Selenium (Se)	0.029		3.67E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.07		1.37E-06
Zinc (Zn)	3.17	9.70E-02	4.85E-05
Ammonium (NH4)	0.6	3.33E-02	3.33E-05
Total	584	2.74E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	312	5.11E+00	5.11E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	250	7.05E+00	7.05E-03
Fluoride (F)	12.9	6.79E-01	6.79E-04
Nitrate + Nitrite (NOX)	51.7	9.57E-01	9.57E-04
Sulfate (SO4)	663	1.38E+01	6.90E-03
Dissolved Silica (H4SiO4)	104.4		1.09E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1394	2.76E+01	

Dissolved Solid Ratio	0.97
Cation-Anion Balance	0.40%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW7
Laboratory Number:	75938
Date Sampled:	11-10-84

Field Measurements	
Temperature(C)	10
pH (standard units)	5.93
Eh (millivolts)	16
Conductivity (micromhos/cm)	1200

Laboratory Measurements	
pH (standard units)	6.4
Conductivity (micromhos/cm)	1870
Total Alkalinity (mg of CaCO3/l)	960
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1130
Sodium Adsorption Ratio	0.61
Total Hardness (mg of CaCO3/l)	976
Ionic Strength	3.30E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.18E-03	1.17E-03	
Calcium (Ca)		109	5.44E+00	2.72E-03
Magnesium (Mg)		171	1.41E+01	7.03E-03
Sodium (Na)		44	1.91E+00	1.91E-03
Potassium (K)		23	5.88E-01	5.88E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		5.61	2.51E-01	1.00E-04
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.3	1.09E-02	5.46E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.032		6.28E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		354	2.23E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1170	1.92E+01	1.92E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		41	1.16E+00	1.16E-03
Fluoride (F)		0.4	2.11E-02	2.11E-05
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)		84	1.75E+00	8.74E-04
Dissolved Silica (H4SiO4)		126.3		1.31E-03
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		1422	2.21E+01	

Dissolved Solid Ratio	1.57
Cation-Anion Balance	0.44%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW8
Laboratory Number:	75940
Date Sampled:	11-10-84

Field Measurements	
Temperature(C)	12
pH (standard units)	6.31
Eh (millivolts)	26
Conductivity (micromhos/cm)	1600

Laboratory Measurements	
pH (standard units)	7.1
Conductivity (micromhos/cm)	2410
Total Alkalinity (mg of CaCO3/l)	1660
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1590
Sodium Adsorption Ratio	0.49
Total Hardness (mg of CaCO3/l)	1663
Ionic Strength	5.28E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	4.94E-04	4.90E-04	
Calcium (Ca)	46	2.30E+00	1.15E-03
Magnesium (Mg)	376	3.09E+01	1.55E-02
Sodium (Na)	46	2.00E+00	2.00E-03
Potassium (K)	22	5.63E-01	5.63E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.05		9.82E-07
Zinc (Zn)	0.03	9.18E-04	4.59E-07
Ammonium (NH4)	0.9	4.99E-02	4.99E-05
Total	491	3.58E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	2024	3.32E+01	3.32E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	14	3.95E-01	3.95E-04
Fluoride (F)	0.25	1.32E-02	1.32E-05
Nitrate + Nitrite (NOX)	< 0.19	3.52E-03	3.52E-06
Sulfate (SO4)	73	1.52E+00	7.60E-04
Dissolved Silica (H4SiO4)	148.2		1.54E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	2259	3.51E+01	

Dissolved Solid Ratio	1.73
Cation-Anion Balance	1.05%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW9
Laboratory Number:	75941
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	10
pH (standard units)	5.9
Eh (millivolts)	40
Conductivity (micromhos/cm)	1320

Laboratory Measurements	
pH (standard units)	6.2
Conductivity (micromhos/cm)	1940
Total Alkalinity (mg of CaCO3/l)	1160
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1260
Sodium Adsorption Ratio	0.5
Total Hardness (mg of CaCO3/l)	1162
Ionic Strength	3.91E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.27E-03	1.26E-03	
Calcium (Ca)	169	8.43E+00	4.22E-03
Magnesium (Mg)	180	1.48E+01	7.40E-03
Sodium (Na)	39	1.70E+00	1.70E-03
Potassium (K)	18	4.60E-01	4.60E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	0.03	1.15E-03	5.77E-07
Iron (Fe)	10.8	4.83E-01	1.93E-04
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.58	2.11E-02	1.06E-05
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.02		3.93E-07
Zinc (Zn)	0.03	9.18E-04	4.59E-07
Ammonium (NH4)	< 0.6	3.33E-02	3.33E-05
Total	418	2.59E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	1414	2.32E+01	2.32E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	29	8.18E-01	8.18E-04
Fluoride (F)	0.35	1.84E-02	1.84E-05
Nitrate + Nitrite (NOX)	0.19	3.52E-03	3.52E-06
Sulfate (SO4)	103	2.14E+00	1.07E-03
Dissolved Silica (H4SiO4)	142.4		1.48E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1689	2.62E+01	

Dissolved Solid Ratio	1.67
Cation-Anion Balance	0.43%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW10
Laboratory Number:	75942
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	14
pH (standard units)	6.24
Eh (millivolts)	39
Conductivity (micromhos/cm)	1220

Laboratory Measurements	
pH (standard units)	6.7
Conductivity (micromhos/cm)	1680
Total Alkalinity (mg of CaCO3/l)	849
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1080
Sodium Adsorption Ratio	0.66
Total Hardness (mg of CaCO3/l)	876
Ionic Strength	2.93E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.80E-04	5.75E-04	
Calcium (Ca)		125	6.24E+00	3.12E-03
Magnesium (Mg)		137	1.13E+01	5.64E-03
Sodium (Na)		45	1.96E+00	1.96E-03
Potassium (K)		15	3.84E-01	3.84E-04
Arsenic (As)		0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)		0.06	2.31E-03	1.15E-06
Iron (Fe)		1.27	5.68E-02	2.27E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		2	7.28E-02	3.64E-05
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)		0.06	1.84E-03	9.18E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		326	2.00E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	1035	1.70E+01	1.70E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	71	2.00E+00	2.00E-03
Fluoride (F)	0.87	4.58E-02	4.58E-05
Nitrate + Nitrite (NOX)	7.83	1.45E-01	1.45E-04
Sulfate (SO4)	43	8.95E-01	4.48E-04
Dissolved Silica (H4SiO4)	103.0		1.07E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1261	2.00E+01	

Dissolved Solid Ratio	1.47
Cation-Anion Balance	0.09%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW11
Laboratory Number:	75943
Date Sampled:	11-13-84

Field Measurements	
Temperature(C)	12
pH (standard units)	6.81
Eh (millivolts)	180
Conductivity (micromhos/cm)	1080

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	1540
Total Alkalinity (mg of CaCO3/l)	473
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	993
Sodium Adsorption Ratio	1.86
Total Hardness (mg of CaCO3/l)	647
Ionic Strength	2.74E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.56E-04	1.55E-04	
Calcium (Ca)	167	8.33E+00	4.17E-03
Magnesium (Mg)	56	4.61E+00	2.30E-03
Sodium (Na)	109	4.74E+00	4.74E-03
Potassium (K)	6	1.53E-01	1.53E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.02		3.93E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	< 0.6	3.33E-02	3.33E-05
Total	339	1.79E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	577	9.45E+00	9.45E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	114	3.22E+00	3.22E-03
Fluoride (F)	0.24	1.26E-02	1.26E-05
Nitrate + Nitrite (NOX)	21.2	3.93E-01	3.93E-04
Sulfate (SO4)	264	5.50E+00	2.75E-03
Dissolved Silica (H4SiO4)	39.7		4.13E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1016	1.86E+01	

Dissolved Solid Ratio	1.36
Cation-Anion Balance	1.91%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW12
Laboratory Number:	75944
Date Sampled:	11-13-84

Field Measurements	
Temperature(C)	10
pH (standard units)	7.43
Eh (millivolts)	160
Conductivity (micromhos/cm)	1610

Laboratory Measurements	
pH (standard units)	8.0
Conductivity (micromhos/cm)	2440
Total Alkalinity (mg of CaCO3/l)	456
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1440
Sodium Adsorption Ratio	3.76
Total Hardness (mg of CaCO3/l)	672
Ionic Strength	3.65E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	3.75E-05	3.72E-05	
Calcium (Ca)	167	8.33E+00	4.17E-03
Magnesium (Mg)	62	5.10E+00	2.55E-03
Sodium (Na)	224	9.74E+00	9.74E-03
Potassium (K)	10	2.56E-01	2.56E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.03	1.09E-03	5.46E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.61		1.20E-05
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	39	2.16E+00	2.16E-03
Total	503	2.56E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	556	9.11E+00	9.11E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	233	6.57E+00	6.57E-03
Fluoride (F)	0.25	1.32E-02	1.32E-05
Nitrate + Nitrite (NOX)	35.6	6.59E-01	6.59E-04
Sulfate (SO4)	475	9.89E+00	4.94E-03
Dissolved Silica (H4SiO4)	53.4		5.55E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1353	2.62E+01	

Dissolved Solid Ratio	1.29
Cation-Anion Balance	1.25%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW13
Laboratory Number:	75945
Date Sampled:	11-07-84

Field Measurements	
Temperature(C)	10
pH (standard units)	7.03
Eh (millivolts)	81
Conductivity (micromhos/cm)	590

Laboratory Measurements	
pH (standard units)	7.7
Conductivity (micromhos/cm)	867
Total Alkalinity (mg of CaCO3/l)	434
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	542
Sodium Adsorption Ratio	0.43
Total Hardness (mg of CaCO3/l)	438
Ionic Strength	1.47E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		9.41E-05	9.33E-05	
Calcium (Ca)		103	5.14E+00	2.57E-03
Magnesium (Mg)		44	3.62E+00	1.81E-03
Sodium (Na)		21	9.13E-01	9.13E-04
Potassium (K)		3	7.67E-02	7.67E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.03	1.09E-03	5.46E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.04		7.85E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		172	9.79E+00	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		529	8.67E+00	8.67E-03
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		16	4.51E-01	4.51E-04
Fluoride (F)		0.22	1.16E-02	1.16E-05
Nitrate + Nitrite (NOX)		16.11	2.98E-01	2.98E-04
Sulfate (SO4)		36	7.50E-01	3.75E-04
Dissolved Silica	(H4SiO4)	42.4		4.41E-04
	(H3SiO4)	ERR	ERR	ERR
	(H2SiO4)	ERR	ERR	ERR
	(HSiO4)	ERR	ERR	ERR
	(SiO4)	ERR	ERR	ERR
Total		640	1.02E+01	

Dissolved Solid Ratio	1.50
Cation-Anion Balance	1.97%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW14
Laboratory Number:	75947
Date Sampled:	11-07-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.95
Eh (millivolts)	160
Conductivity (micromhos/cm)	600

Laboratory Measurements	
pH (standard units)	7.2
Conductivity (micromhos/cm)	879
Total Alkalinity (mg of CaCO3/l)	446
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	526
Sodium Adsorption Ratio	0.42
Total Hardness (mg of CaCO3/l)	475
Ionic Strength	1.59E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.13E-04	1.12E-04	
Calcium (Ca)		126	6.29E+00	3.14E-03
Magnesium (Mg)		39	3.21E+00	1.60E-03
Sodium (Na)		21	9.13E-01	9.13E-04
Potassium (K)		3	7.67E-02	7.67E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.60	3.33E-02	3.33E-05
Total		190	1.05E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	544	8.91E+00	8.91E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	7	1.97E-01	1.97E-04
Fluoride (F)	0.28	1.47E-02	1.47E-05
Nitrate + Nitrite (NOX)	12.95	2.40E-01	2.40E-04
Sulfate (SO4)	58	1.21E+00	6.04E-04
Dissolved Silica (H4SiO4)	38.3		3.98E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
			0
Total	660	1.06E+01	

Dissolved Solid Ratio	1.62
Cation-Anion Balance	0.22%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW15
Laboratory Number:	75948
Date Sampled:	11-07-84

Field Measurements	
Temperature(C)	10
pH (standard units)	7.04
Eh (millivolts)	88
Conductivity (micromhos/cm)	590

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	864
Total Alkalinity (mg of CaCO3/l)	427
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	512
Sodium Adsorption Ratio	0.38
Total Hardness (mg of CaCO3/l)	480
Ionic Strength	1.59E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	9.19E-05	9.12E-05	
Calcium (Ca)	123	6.14E+00	3.07E-03
Magnesium (Mg)	42	3.45E+00	1.73E-03
Sodium (Na)	19	8.26E-01	8.26E-04
Potassium (K)	3	7.67E-02	7.67E-05
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.07		1.37E-06
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	< 0.60	3.33E-02	3.33E-05
Total	188	1.05E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	521	8.53E+00	8.53E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	13	3.67E-01	3.67E-04
Fluoride (F)	0.19	1.00E-02	1.00E-05
Nitrate + Nitrite (NOX)	16.31	3.02E-01	3.02E-04
Sulfate (SO4)	62	1.29E+00	6.45E-04
Dissolved Silica (H4SiO4)	39.4		4.10E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	651	1.05E+01	

Dissolved Solid Ratio	1.64
Cation-Anion Balance	0.16%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW16
Laboratory Number:	75949
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	11
pH (standard units)	6.42
Eh (millivolts)	77
Conductivity (micromhos/cm)	1120

Laboratory Measurements	
pH (standard units)	7.0
Conductivity (micromhos/cm)	1740
Total Alkalinity (mg of CaCO3/l)	563
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1090
Sodium Adsorption Ratio	1.80
Total Hardness (mg of CaCO3/l)	681
Ionic Strength	2.87E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.83E-04	3.80E-04	
Calcium (Ca)		139	6.94E+00	3.47E-03
Magnesium (Mg)		81	6.66E+00	3.33E-03
Sodium (Na)		108	4.70E+00	4.70E-03
Potassium (K)		20	5.12E-01	5.12E-04
Arsenic (As)		0.039		5.21E-07
Cadmium (Cd)		1.41	2.51E-02	1.25E-05
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.21	7.64E-03	3.82E-06
Selenium (Se)				
Silver (Ag)				
Vanadium (V)				
Zinc (Zn)				
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		350	1.89E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	686	1.12E+01	1.12E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	121	3.41E+00	3.41E-03
Fluoride (F)	7.43	3.91E-01	3.91E-04
Nitrate + Nitrite (NOX)	39.3	7.28E-01	7.28E-04
Sulfate (SO4)	222	4.62E+00	2.31E-03
Dissolved Silica (H4SiO4)	81.8		8.51E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1158	2.04E+01	

Dissolved Solid Ratio	1.38
Cation-Anion Balance	3.88%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW17
Laboratory Number:	75950
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.79
Eh (millivolts)	32
Conductivity (micromhos/cm)	1080

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	2140
Total Alkalinity (mg of CaCO3/l)	361
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1400
Sodium Adsorption Ratio	2.19
Total Hardness (mg of CaCO3/l)	805
Ionic Strength	3.47E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.63E-04	1.62E-04	
Calcium (Ca)		72	3.59E+00	1.80E-03
Magnesium (Mg)		152	1.25E+01	6.25E-03
Sodium (Na)		143	6.22E+00	6.22E-03
Potassium (K)		26	6.65E-01	6.65E-04
Arsenic (As)		0.005		6.67E-08
Cadmium (Cd)		0.087	1.55E-03	7.74E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		1.4	5.10E-02	2.55E-05
Selenium (Se)		0.008		1.01E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.03		5.89E-07
Zinc (Zn)		0.16	4.90E-03	2.45E-06
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		395	2.31E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	440	7.21E+00	7.21E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	301	8.49E+00	8.49E-03
Fluoride (F)	8.14	4.28E-01	4.28E-04
Nitrate + Nitrite (NOX)	5.0	9.26E-02	9.26E-05
Sulfate (SO4)	338	7.04E+00	3.52E-03
Dissolved Silica (H4SiO4)	79.4		8.26E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1172	2.33E+01	

Dissolved Solid Ratio	1.12
Cation-Anion Balance	0.41%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW18
Laboratory Number:	75952
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	12
pH (standard units)	6.25
Eh (millivolts)	21
Conductivity (micromhos/cm)	1230

Laboratory Measurements	
pH (standard units)	6.6
Conductivity (micromhos/cm)	1800
Total Alkalinity (mg of CaCO3/l)	931
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1090
Sodium Adsorption Ratio	0.49
Total Hardness (mg of CaCO3/l)	922
Ionic Strength	3.00E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.67E-04	5.62E-04	
Calcium (Ca)		71	3.54E+00	1.77E-03
Magnesium (Mg)		181	1.49E+01	7.45E-03
Sodium (Na)		34	1.48E+00	1.48E-03
Potassium (K)		21	5.37E-01	5.37E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		4.36	1.95E-01	7.81E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.19	6.92E-03	3.46E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)		0.04	1.22E-03	6.12E-07
Ammonium (NH4)	<	0.60	3.33E-02	3.33E-05
Total		312	2.07E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		1135	1.86E+01	1.86E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		20	5.64E-01	5.64E-04
Fluoride (F)		0.25	1.32E-02	1.32E-05
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)		33	6.87E-01	3.44E-04
Dissolved Silica (H4SiO4)		12.39		1.29E-04
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		1201	1.99E+01	

Dissolved Solid Ratio	1.39
Cation-Anion Balance	2.01%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW19
Laboratory Number:	76007
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	12
pH (standard units)	7.01
Eh (millivolts)	97
Conductivity (micromhos/cm)	900

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	1330
Total Alkalinity (mg of CaCO3/l)	342
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	972
Sodium Adsorption Ratio	0.81
Total Hardness (mg of CaCO3/l)	671
Ionic Strength	2.54E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	9.85E-05	9.77E-05	
Calcium (Ca)	137	6.84E+00	3.42E-03
Magnesium (Mg)	80	6.58E+00	3.29E-03
Sodium (Na)	48	2.09E+00	2.09E-03
Potassium (K)	9	2.30E-01	2.30E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	0.16	7.16E-03	2.86E-06
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	< 0.6	3.33E-02	3.33E-05
Total	275	1.58E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	417	6.83E+00	6.83E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	77	2.17E+00	2.17E-03
Fluoride (F)	1.05	5.53E-02	5.53E-05
Nitrate + Nitrite (NOX)	37.47	6.94E-01	6.94E-04
Sulfate (SO4)	286	5.95E+00	2.98E-03
Dissolved Silica (H4SiO4)	59.5		6.19E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	878	1.57E+01	

Dissolved Solid Ratio	1.19
Cation-Anion Balance	0.22%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW20
Laboratory Number:	76008
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.76
Eh (millivolts)	31
Conductivity (micromhos/cm)	775

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	1110
Total Alkalinity (mg of CaCO3/l)	346
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	800
Sodium Adsorption Ratio	0.78
Total Hardness (mg of CaCO3/l)	570
Ionic Strength	2.14E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.75E-04	1.74E-04	
Calcium (Ca)		113	5.64E+00	2.82E-03
Magnesium (Mg)		70	5.76E+00	2.88E-03
Sodium (Na)		43	1.87E+00	1.87E-03
Potassium (K)		8	2.05E-01	2.05E-04
Arsenic (As)		0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.04		7.85E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		235	1.35E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	422	6.91E+00	6.91E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	58	1.64E+00	1.64E-03
Fluoride (F)	1.1	5.79E-02	5.79E-05
Nitrate + Nitrite (NOX)	29.14	5.40E-01	5.40E-04
Sulfate (SO4)	210	4.37E+00	2.19E-03
Dissolved Silica (H4SiO4)	57.8		6.01E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	778	1.35E+01	

Dissolved Solid Ratio	1.27
Cation-Anion Balance	0.03%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW21
Laboratory Number:	76009
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	12
pH (standard units)	6.42
Eh (millivolts)	15
Conductivity (micromhos/cm)	1300

Laboratory Measurements	
pH (standard units)	6.8
Conductivity (micromhos/cm)	1900
Total Alkalinity (mg of CaCO3/l)	1100
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1210
Sodium Adsorption Ratio	0.49
Total Hardness (mg of CaCO3/l)	1116
Ionic Strength	3.65E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.83E-04	3.80E-04	
Calcium (Ca)		53	2.64E+00	1.32E-03
Magnesium (Mg)		239	1.97E+01	9.83E-03
Sodium (Na)		38	1.65E+00	1.65E-03
Potassium (K)		22	5.63E-01	5.63E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		3.01	1.35E-01	5.39E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.14	5.10E-03	2.55E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.04		7.85E-07
Zinc (Zn)		0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		356	2.47E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	1341	2.20E+01	2.20E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	14	3.95E-01	3.95E-04
Fluoride (F)	0.22	1.16E-02	1.16E-05
Nitrate + Nitrite (NOX)	0.85	1.57E-02	1.57E-05
Sulfate (SO4)	84	1.75E+00	8.74E-04
Dissolved Silica (H4SiO4)	122.8		1.28E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1563	2.41E+01	

Dissolved Solid Ratio	1.59
Cation-Anion Balance	1.11%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW22
Laboratory Number:	75953
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	12
pH (standard units)	7.12
Eh (millivolts)	36
Conductivity (micromhos/cm)	1990

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	2930
Total Alkalinity (mg of CaCO3/l)	224
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	2200
Sodium Adsorption Ratio	2.34
Total Hardness (mg of CaCO3/l)	1166
Ionic Strength	5.27E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		7.65E-05	7.59E-05	
Calcium (Ca)		253	1.26E+01	6.31E-03
Magnesium (Mg)		130	1.07E+01	5.35E-03
Sodium (Na)		184	8.00E+00	8.00E-03
Potassium (K)		17	4.35E-01	4.35E-04
Arsenic (As)		0.015		2.00E-07
Cadmium (Cd)		0.07	1.25E-03	6.23E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		0.17	7.61E-03	3.04E-06
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		1.13	4.11E-02	2.06E-05
Selenium (Se)		0.023		2.91E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.13		2.55E-06
Zinc (Zn)		0.3	9.18E-03	4.59E-06
Ammonium (NH4)		7.5	4.16E-01	4.16E-04
Total		593	3.22E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	273	4.47E+00	4.47E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	313	8.83E+00	8.83E-03
Fluoride (F)	9.33	4.91E-01	4.91E-04
Nitrate + Nitrite (NOX)	59.4	1.10E+00	1.10E-03
Sulfate (SO4)	847	1.76E+01	8.82E-03
Dissolved Silica (H4SiO4)	98.6		1.03E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1600	3.25E+01	

Dissolved Solid Ratio	1.00
Cation-Anion Balance	0.46%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW23
Laboratory Number:	75954
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	11
pH (standard units)	6.01
Eh (millivolts)	19
Conductivity (micromhos/cm)	1350

Laboratory Measurements	
pH (standard units)	6.3
Conductivity (micromhos/cm)	2010
Total Alkalinity (mg of CaCO3/l)	659
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1470
Sodium Adsorption Ratio	0.70
Total Hardness (mg of CaCO3/l)	1095
Ionic Strength	4.14E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	9.85E-04	9.77E-04	
Calcium (Ca)	188	9.38E+00	4.69E-03
Magnesium (Mg)	152	1.25E+01	6.25E-03
Sodium (Na)	53	2.31E+00	2.31E-03
Potassium (K)	26	6.65E-01	6.65E-04
Arsenic (As)	0.007		9.34E-08
Cadmium (Cd)	0.034	6.05E-04	3.02E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	5.5	2.46E-01	9.85E-05
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.32	1.16E-02	5.82E-06
Selenium (Se)	0.007		8.87E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.03		5.89E-07
Zinc (Zn)	0.12	3.67E-03	1.84E-06
Ammonium (NH4)	1.0	5.54E-02	5.54E-05
Total	426	2.52E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	803	1.32E+01	1.32E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	112	3.16E+00	3.16E-03
Fluoride (F)	1.31	6.89E-02	6.89E-05
Nitrate + Nitrite (NOX)	0.8	1.48E-02	1.48E-05
Sulfate (SO4)	455	9.47E+00	4.74E-03
Dissolved Silica (H4SiO4)	146.5		1.52E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1519	2.59E+01	

Dissolved Solid Ratio	1.32
Cation-Anion Balance	1.39%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW24
Laboratory Number:	75955
Date Sampled:	11-08-84

Field Measurements	
Temperature(C)	12
pH (standard units)	10.5
Eh (millivolts)	-7
Conductivity (micromhos/cm)	1475

Laboratory Measurements	
pH (standard units)	10.1
Conductivity (micromhos/cm)	2150
Total Alkalinity (mg of CaCO3/l)	172
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1410
Sodium Adsorption Ratio	2.55
Total Hardness (mg of CaCO3/l)	689
Ionic Strength	3.22E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	3.19E-08	3.16E-08	
Calcium (Ca)	225	1.12E+01	5.61E-03
Magnesium (Mg)	31	2.55E+00	1.28E-03
Sodium (Na)	154	6.70E+00	6.70E-03
Potassium (K)	14	3.58E-01	3.58E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.039	6.94E-04	3.47E-07
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	0.25	1.12E-02	4.48E-06
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.04	1.46E-03	7.28E-07
Selenium (Se)	0.026		3.29E-07
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.09		1.77E-06
Zinc (Zn)	0.19	5.81E-03	2.91E-06
Ammonium (NH4)	6.1	3.38E-01	3.38E-04
Total	431	2.12E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	179	2.93E+00	2.93E-03
Carbonate (CO3)	15	5.00E-01	2.50E-04
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	5.1	3.00E-01	3.00E-04
Chloride (Cl)	233	6.57E+00	6.57E-03
Fluoride (F)	3.58	1.88E-01	1.88E-04
Nitrate + Nitrite (NOX)	42.8	7.92E-01	7.92E-04
Sulfate (SO4)	464	9.66E+00	4.83E-03
Dissolved Silica (H4SiO4)	11.7		1.22E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	954	2.09E+01	

Dissolved Solid Ratio	0.98
Cation-Anion Balance	0.58%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW25
Laboratory Number:	75956
Date Sampled:	11-12-84

Field Measurements	
Temperature(C)	11
pH (standard units)	9.40
Eh (millivolts)	-1
Conductivity (micromhos/cm)	810

Laboratory Measurements	
pH (standard units)	9.8
Conductivity (micromhos/cm)	1200
Total Alkalinity (mg of CaCO3/l)	222
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	766
Sodium Adsorption Ratio	3.17
Total Hardness (mg of CaCO3/l)	533
Ionic Strength	2.84E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.01E-07	3.98E-07	
Calcium (Ca)		27	1.35E+00	6.74E-04
Magnesium (Mg)		113	9.29E+00	4.65E-03
Sodium (Na)		168	7.31E+00	7.31E-03
Potassium (K)		27	6.91E-01	6.91E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		336	1.87E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		167	2.74E+00	2.74E-03
Carbonate (CO3)		51	1.70E+00	8.50E-04
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		106	2.99E+00	2.99E-03
Fluoride (F)		0.25	1.32E-02	1.32E-05
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)		521	1.08E+01	5.42E-03
Dissolved Silica (H4SiO4)		20.74		2.16E-04
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		866	1.83E+01	

Dissolved Solid Ratio	1.57
Cation-Anion Balance	1.04%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW26
Laboratory Number:	75957
Date Sampled:	11-12-84

Field Measurements	
Temperature(C)	13
pH (standard units)	7.99
Eh (millivolts)	110
Conductivity (micromhos/cm)	1350

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	2080
Total Alkalinity (mg of CaCO3/l)	371
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1440
Sodium Adsorption Ratio	1.17
Total Hardness (mg of CaCO3/l)	928
Ionic Strength	3.62E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		1.03E-05	1.02E-05	
Calcium (Ca)		108	5.39E+00	2.69E-03
Magnesium (Mg)		160	1.32E+01	6.58E-03
Sodium (Na)		82	3.57E+00	3.57E-03
Potassium (K)		19	4.86E-01	4.86E-04
Arsenic (As)		0.007		9.34E-08
Cadmium (Cd)		0.011	1.96E-04	9.79E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		1.15	4.19E-02	2.09E-05
Selenium (Se)		0.006		7.60E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.04		7.85E-07
Zinc (Zn)		0.04	1.22E-03	6.12E-07
Ammonium (NH4)		0.9	4.99E-02	4.99E-05
Total		371	2.27E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	452	7.41E+00	7.41E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	152	4.29E+00	4.29E-03
Fluoride (F)	0.63	3.32E-02	3.32E-05
Nitrate + Nitrite (NOX)	25.75	4.77E-01	4.77E-04
Sulfate (SO4)	456	9.49E+00	4.75E-03
Dissolved Silica (H4SiO4)	80.8		8.41E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1167	2.17E+01	

Dissolved Solid Ratio	1.07
Cation-Anion Balance	2.24%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW27
Laboratory Number:	75958
Date Sampled:	11-12-84

Field Measurements	
Temperature(C)	13
pH (standard units)	7.46
Eh (millivolts)	120
Conductivity (micromhos/cm)	1280

Laboratory Measurements	
pH (standard units)	7.1
Conductivity (micromhos/cm)	1280
Total Alkalinity (mg of CaCO3/l)	429
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	170
Sodium Adsorption Ratio	1.73
Total Hardness (mg of CaCO3/l)	725
Ionic Strength	3.17E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.50E-05	3.47E-05	
Calcium (Ca)		170	8.48E+00	4.24E-03
Magnesium (Mg)		73	6.00E+00	3.00E-03
Sodium (Na)		107	4.65E+00	4.65E-03
Potassium (K)		34	8.70E-01	8.70E-04
Arsenic (As)		0.011		1.47E-07
Cadmium (Cd)		0.039	6.94E-04	3.47E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		0.12	5.37E-03	2.15E-06
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.36	1.31E-02	6.55E-06
Selenium (Se)		0.048		6.08E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.06		1.18E-06
Zinc (Zn)		0.1	3.06E-03	1.53E-06
Ammonium (NH4)		1.2	6.65E-02	6.65E-05
Total		386	2.01E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	523	8.57E+00	8.57E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	71	2.00E+00	2.00E-03
Fluoride (F)	4.11	2.16E-01	2.16E-04
Nitrate + Nitrite (NOX)	50	9.26E-01	9.26E-04
Sulfate (SO4)	414	8.62E+00	4.31E-03
Dissolved Silica (H4SiO4)	79.4		8.26E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1141	2.03E+01	

Dissolved Solid Ratio	8.99
Cation-Anion Balance	0.58%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW28
Laboratory Number:	75959
Date Sampled:	11-12-84

Field Measurements	
Temperature(C)	11
pH (standard units)	6.29
Eh (millivolts)	180
Conductivity (micromhos/cm)	1010

Laboratory Measurements	
pH (standard units)	6.5
Conductivity (micromhos/cm)	1520
Total Alkalinity (mg of CaCO3/l)	842
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	920
Sodium Adsorption Ratio	0.55
Total Hardness (mg of CaCO3/l)	812
Ionic Strength	2.62E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.17E-04	5.13E-04	
Calcium (Ca)		177	8.83E+00	4.42E-03
Magnesium (Mg)		90	7.40E+00	3.70E-03
Sodium (Na)		36	1.57E+00	1.57E-03
Potassium (K)		8	2.05E-01	2.05E-04
Arsenic (As)		0.006		8.01E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		312	1.80E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	1026	1.68E+01	1.68E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	22	6.21E-01	6.21E-04
Fluoride (F)	0.19	1.00E-02	1.00E-05
Nitrate + Nitrite (NOX)	15.15	2.81E-01	2.81E-04
Sulfate (SO4)	11	2.29E-01	1.15E-04
Dissolved Silica (H4SiO4)	87.6		9.11E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1162	1.80E+01	

Dissolved Solid Ratio	1.60
Cation-Anion Balance	0.23%

WATER-LEVEL DATA FOR TEST WELL: TW-19

MEASURING POINT (MP)
1 MP ELEVATION = 5894.05 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10- 1-84	1700	274.708	1	3	23.95	23.95	5870.10
10- 1-84	1930	274.813	1	3	23.98	23.98	5870.07
10- 2-84	710	275.299	1	3	23.95	23.95	5870.10
10- 3-84	715	276.302	1	3	24.13	24.13	5869.92
10- 8-84	930	281.396	1	3	24.21	24.21	5869.84
10- 9-84	1000	282.417	1	3	24.13	24.13	5869.92
10-12-84	1200	285.500	1	5	24.02	24.02	5870.03
10-16-84	850	289.368	1	3	24.02	24.02	5870.03
10-18-84	1050	291.451	1	3	24.04	24.04	5870.01
10-22-84	920	295.389	1	3	23.97	23.97	5870.08
10-25-84	1105	298.462	1	3	23.93	23.93	5870.12
10-27-84	1430	300.604	1	3	23.68	23.68	5870.37
10-29-84	1610	302.674	1	3	23.60	23.60	5870.45
11- 1-84	1025	305.434	1	3	23.69	23.69	5870.36
11- 3-84	1305	307.545	1	3	23.75	23.75	5870.30
11- 6-84	1535	310.649	1	3	23.82	23.82	5870.23
11-13-84	1600	317.667	1	3	24.03	24.03	5870.02
11-16-84	1630	320.688	1	3	24.03	24.03	5870.02
11-19-84	805	323.337	1	3	24.08	24.08	5869.97
11-21-84	1125	325.476	1	3	24.10	24.10	5869.95
11-26-84	1700	330.708	1	3	24.03	24.03	5870.02
11-28-84	908	332.381	1	3	24.17	24.17	5869.88
11-30-84	1004	334.419	1	3	24.21	24.21	5869.84
12- 3-84	1421	337.598	1	3	24.28	24.28	5869.77
12- 8-84	1620	342.681	1	3	24.36	24.36	5869.69
12-10-84	1320	344.556	1	3	24.42	24.42	5869.63
12-11-84	822	345.349	1	3	24.38	24.38	5869.67
12-11-84	1135	345.483	1	3	24.54	24.54	5869.51
12-11-84	1243	345.530	1	3	24.47	24.47	5869.58
12-11-84	1425	345.601	1	3	24.60	24.60	5869.45
12-11-84	1500	345.625	1	3	24.82	24.82	5869.23
12-11-84	1515	345.635	1	3	24.80	24.80	5869.25
12-12-84	815	346.344	1	3	24.43	24.43	5869.62
12-14-84	1445	348.615	1	3	24.41	24.41	5869.64
12-15-84	1250	349.535	1	3	24.41	24.41	5869.64
12-15-84	1335	349.566	1	5	24.41	24.41	5869.64
12-15-84	1345	349.573	1	5	24.42	24.42	5869.63
12-15-84	1400	349.583	1	5	24.42	24.42	5869.63
12-15-84	1415	349.594	1	5	24.44	24.44	5869.61
12-15-84	1430	349.604	1	5	24.46	24.46	5869.59
12-15-84	1445	349.615	1	5	24.47	24.47	5869.58
12-15-84	1500	349.625	1	5	24.48	24.48	5869.57
12-15-84	1530	349.646	1	5	24.50	24.50	5869.55
12-15-84	1600	349.667	1	5	24.52	24.52	5869.53

TW-19 (CONT.)

12-15-84	1630	349.688	1	5	24.53	24.53	5869.52
12-15-84	1700	349.708	1	5	24.54	24.54	5869.51
12-15-84	1730	349.729	1	5	24.56	24.56	5869.49
12-15-84	1800	349.750	1	5	24.57	24.57	5869.48
12-15-84	1800	349.750	1	3	24.59	24.59	5869.46
12-15-84	1900	349.792	1	5	24.60	24.60	5869.45
12-15-84	2000	349.833	1	5	24.62	24.62	5869.43
12-15-84	2100	349.875	1	5	24.64	24.64	5869.41
12-15-84	2200	349.917	1	5	24.66	24.66	5869.39
12-15-84	2300	349.958	1	5	24.67	24.67	5869.38
12-15-84	2400	350.000	1	5	24.69	24.69	5869.36
12-16-84	100	350.042	1	5	24.70	24.70	5869.35
12-16-84	200	350.083	1	5	24.71	24.71	5869.34
12-16-84	300	350.125	1	5	24.72	24.72	5869.33
12-16-84	400	350.167	1	5	24.73	24.73	5869.32
12-16-84	500	350.208	1	5	24.74	24.74	5869.31
12-16-84	600	350.250	1	5	24.75	24.75	5869.30
12-16-84	700	350.292	1	5	24.76	24.76	5869.29
12-16-84	800	350.333	1	5	24.76	24.76	5869.29
12-16-84	900	350.375	1	5	24.77	24.77	5869.28
12-16-84	1000	350.417	1	5	24.78	24.78	5869.27
12-16-84	1050	350.451	1	3	24.81	24.81	5869.24
12-16-84	1220	350.514	1	5	24.82	24.82	5869.23
12-16-84	1230	350.521	1	5	24.80	24.80	5869.25
12-16-84	1245	350.531	1	5	24.79	24.79	5869.26
12-16-84	1300	350.542	1	5	24.78	24.78	5869.27
12-16-84	1315	350.552	1	5	24.77	24.77	5869.28
12-16-84	1330	350.563	1	5	24.76	24.76	5869.29
12-16-84	1345	350.573	1	5	24.75	24.75	5869.30
12-16-84	1400	350.583	1	5	24.74	24.74	5869.31
12-16-84	1430	350.604	1	5	24.73	24.73	5869.32
12-16-84	1500	350.625	1	5	24.72	24.72	5869.33
12-16-84	1530	350.646	1	5	24.71	24.71	5869.34
12-16-84	1600	350.667	1	5	24.70	24.70	5869.35
12-16-84	1700	350.708	1	5	24.68	24.68	5869.37
12-16-84	1800	350.750	1	5	24.67	24.67	5869.38
12-16-84	1900	350.792	1	5	24.66	24.66	5869.39
12-16-84	2000	350.833	1	5	24.65	24.65	5869.40
12-16-84	2100	350.875	1	5	24.63	24.63	5869.42
12-16-84	2200	350.917	1	5	24.63	24.63	5869.42
12-16-84	2300	350.958	1	5	24.62	24.62	5869.43
12-16-84	2400	351.000	1	5	24.62	24.62	5869.43
12-17-84	100	351.042	1	5	24.61	24.61	5869.44
12-17-84	200	351.083	1	5	24.61	24.61	5869.44
12-17-84	300	351.125	1	5	24.60	24.60	5869.45
12-17-84	400	351.167	1	5	24.60	24.60	5869.45
12-17-84	500	351.208	1	5	24.59	24.59	5869.46
12-17-84	700	351.292	1	5	24.58	24.58	5869.47
12-17-84	900	351.375	1	5	24.57	24.57	5869.48
12-17-84	1035	351.441	1	3	24.54	24.54	5869.51
12-18-84	1030	352.438	1	3	24.52	24.52	5869.53
1-28-85	1530	209.646	1	3	24.90	24.90	5869.15
1-31-85	1135	212.483	1	3	24.90	24.90	5869.15
2- 2-85	820	183.347	1	3	24.90	24.90	5869.15
2- 4-85	1235	185.524	1	3	24.85	24.85	5869.20
2- 6-85	1040	187.444	1	3	24.77	24.77	5869.28
2-11-85	1055	192.455	1	3	24.87	24.87	5869.18

TW-19 (CONT.)

2-13-85	1055	194.455	1	3	24.97	24.97	5869.08
2-15-85	1045	196.448	1	3	25.00	25.00	5869.05

WATER-LEVEL DATA FOR TEST WELL: TW-21

MEASURING POINT (MP)
1 MP ELEVATION = 5894.41 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10- 9-84	1000	282.417	1	3	19.88	19.88	5874.53
10-11-84	930	284.396	1	3	19.88	19.88	5874.53
10-15-84	1010	288.424	1	3	19.57	19.57	5874.84
10-18-84	1100	291.458	1	3	19.68	19.68	5874.73
10-18-84	1530	291.646	1	3	19.75	19.75	5874.66
10-20-84	1200	293.500	1	5	19.68	19.68	5874.73
10-22-84	1200	295.500	1	5	19.72	19.72	5874.69
10-24-84	1200	297.500	1	5	19.69	19.69	5874.72
10-25-84	1105	298.462	1	3	19.68	19.68	5874.73
10-26-84	1400	299.583	1	5	19.54	19.54	5874.87
10-28-84	1200	301.500	1	5	19.58	19.58	5874.83
10-30-84	1200	303.500	1	5	19.60	19.60	5874.81
10-31-84	1200	304.500	1	5	19.64	19.64	5874.77
11- 1-84	1020	305.431	1	3	19.70	19.70	5874.71
11- 3-84	1200	307.500	1	5	19.66	19.66	5874.75
11- 5-84	800	309.333	1	3	19.75	19.75	5874.66
11- 6-84	1533	310.648	1	3	19.70	19.70	5874.71
11-13-84	1425	317.601	1	3	19.82	19.82	5874.59
11-16-84	1423	320.599	1	3	19.82	19.82	5874.59
11-18-84	1200	322.500	1	5	19.81	19.81	5874.60
11-20-84	1200	324.500	1	5	19.83	19.83	5874.58
11-21-84	1125	325.476	1	3	19.91	19.91	5874.50
11-26-84	1700	330.708	1	3	19.91	19.91	5874.50
11-28-84	905	332.378	1	3	19.96	19.96	5874.45
11-30-84	1004	334.419	1	3	20.00	20.00	5874.41
12- 3-84	1421	337.598	1	3	20.09	20.09	5874.32
12- 8-84	1620	342.681	1	3	20.18	20.18	5874.23
12-10-84	1320	344.556	1	3	20.18	20.18	5874.23
12-11-84	822	345.349	1	3	20.16	20.16	5874.25
12-11-84	1243	345.530	1	3	20.24	20.24	5874.17
12-11-84	1425	345.601	1	3	20.21	20.21	5874.20
12-11-84	1500	345.625	1	3	20.19	20.19	5874.22
12-11-84	1515	345.635	1	3	20.21	20.21	5874.20
12-12-84	815	346.344	1	3	20.16	20.16	5874.25
12-15-84	1250	349.535	1	3	20.27	20.27	5874.14
12-15-84	1650	349.701	1	3	20.26	20.26	5874.15
12-15-84	1925	349.809	1	3	20.27	20.27	5874.14
12-16-84	45	350.031	1	3	20.27	20.27	5874.14
12-16-84	255	350.122	1	3	20.27	20.27	5874.14
12-16-84	500	350.208	1	3	20.29	20.29	5874.12
12-16-84	705	350.295	1	3	20.31	20.31	5874.10
12-16-84	835	350.358	1	3	20.29	20.29	5874.12
12-16-84	1040	350.444	1	3	20.27	20.27	5874.14
12-16-84	1210	350.507	1	3	20.29	20.29	5874.12

TW-21 (CONT.)

12-17-84	900	351.375	1	3	20.44	20.44	5873.97
1-28-85	1525	209.642	1	3	20.90	20.90	5873.51
1-31-85	1135	212.483	1	3	21.26	21.26	5873.15
2- 2-85	820	183.347	1	3	21.26	21.26	5873.15
2- 4-85	1235	185.524	1	3	21.26	21.26	5873.15
2- 6-85	1040	187.444	1	3	21.19	21.19	5873.22
2-11-85	1055	192.455	1	3	20.62	20.62	5873.79
2-13-85	1055	194.455	1	3	20.75	20.75	5873.66
2-15-85	1045	196.448	1	3	20.73	20.73	5873.68

WATER-LEVEL DATA FOR TEST WELL: TW-20

MEASURING POINT (MP)
1 MP ELEVATION = 5894.26 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10- 2-84	1300	275.542	1	3	24.23	24.23	5870.03
10- 3-84	715	276.302	1	3	24.26	24.26	5870.00
10- 8-84	930	281.396	1	3	24.39	24.39	5869.87
10- 9-84	1000	282.417	1	3	24.33	24.33	5869.93
10-12-84	1200	285.500	1	5	24.22	24.22	5870.04
10-16-84	910	289.382	1	3	24.23	24.23	5870.03
10-18-84	900	291.375	1	3	24.23	24.23	5870.03
10-18-84	1045	291.448	1	3	24.28	24.28	5869.98
10-19-84	1200	292.500	1	5	24.24	24.24	5870.02
10-20-84	1200	293.500	1	5	24.22	24.22	5870.04
10-22-84	1200	295.500	1	5	24.21	24.21	5870.05
10-23-84	1400	296.583	1	3	24.20	24.20	5870.06
10-25-84	1200	298.500	1	5	24.16	24.16	5870.10
10-27-84	1200	300.500	1	5	23.92	23.92	5870.34
10-29-84	1200	302.500	1	5	23.85	23.85	5870.41
10-30-84	855	303.372	1	3	23.82	23.82	5870.44
10-31-84	1200	304.500	1	5	23.84	23.84	5870.43
11- 1-84	1200	305.500	1	5	23.89	23.89	5870.38
11- 3-84	1200	307.500	1	5	23.93	23.93	5870.34
11- 4-84	1200	308.500	1	5	23.97	23.97	5870.29
11- 6-84	1535	310.649	1	3	24.03	24.03	5870.23
11-13-84	1600	317.667	1	3	24.26	24.26	5870.00
11-16-84	1630	320.688	1	3	24.26	24.26	5870.00
11-19-84	805	323.337	1	3	24.33	24.33	5869.93
11-21-84	1110	325.465	1	3	24.33	24.33	5869.93
11-23-84	800	327.333	1	5	24.38	24.38	5869.88
11-25-84	1200	329.500	1	5	24.39	24.39	5869.87
11-27-84	1200	331.500	1	5	24.44	24.44	5869.82
11-28-84	903	332.377	1	3	24.39	24.39	5869.87
11-30-84	1000	334.417	1	5	24.44	24.44	5869.82
12- 2-84	1200	336.500	1	5	24.50	24.50	5869.76
12- 4-84	1800	338.750	1	5	24.54	24.54	5869.72
12- 5-84	1000	339.417	1	5	24.56	24.56	5869.70
12- 8-84	1620	342.681	1	3	24.57	24.57	5869.69
12-10-84	1315	344.552	1	3	24.61	24.61	5869.65
12-11-84	900	345.375	1	5	25.61	25.61	5868.65
12-12-84	815	346.344	1	3	24.67	24.67	5869.59
12-14-84	1445	348.615	1	3	24.65	24.65	5869.61
12-16-84	1226	350.518	1	3	25.06	25.06	5869.20
12-16-84	1545	350.656	1	3	24.98	24.98	5869.28
12-17-84	900	351.375	1	3	24.84	24.84	5869.42
12-18-84	1030	352.438	1	3	24.74	24.74	5869.52
1-28-85	1525	209.642	1	3	25.15	25.15	5869.11
1-29-85	810	210.340	1	3	25.19	25.19	5869.07

TW-20 (CONT.)

1-30-85	1200	211.500	1	5	25.18	25.18	5869.08
2- 1-85	1200	182.500	1	5	25.14	25.14	5869.12
2- 4-85	1230	185.521	1	3	25.10	25.10	5869.16
2- 6-85	1200	187.500	1	5	25.08	25.08	5869.18
2- 8-85	1200	189.500	1	5	25.10	25.10	5869.16
2-11-85	1055	192.455	1	3	25.11	25.11	5869.15
2-13-85	1200	194.500	1	5	25.15	25.15	5869.11
2-15-85	1200	196.500	1	5	25.20	25.20	5869.06
2-18-85	1100	199.458	1	5	25.23	25.23	5869.03

WATER-LEVEL DATA FOR TEST WELL: TW-13

MEASURING POINT (MP)
1 MP ELEVATION = 5989.03 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-20-84	830	263.354	1	3	13.50	13.50	5975.53
9-21-84	757	264.331	1	3	13.48	13.48	5975.55
9-22-84	900	265.375	1	3	13.50	13.50	5975.53
9-24-84	1710	267.715	1	3	13.45	13.45	5975.58
9-25-84	1100	268.458	1	3	13.51	13.51	5975.52
9-25-84	1415	268.594	1	3	13.51	13.51	5975.52
10- 3-84	915	276.385	1	3	13.47	13.47	5975.56
10- 9-84	930	282.396	1	3	13.53	13.53	5975.50
10-11-84	830	284.354	1	3	13.52	13.52	5975.51
10-15-84	1115	288.469	1	3	13.50	13.50	5975.53
10-18-84	1425	291.601	1	3	13.48	13.48	5975.55
10-22-84	1005	295.420	1	3	13.43	13.43	5975.60
10-25-84	1055	298.455	1	3	13.55	13.55	5975.48
10-27-84	1345	300.573	1	3	13.52	13.52	5975.51
10-29-84	820	302.347	1	3	13.55	13.55	5975.48
11- 1-84	900	305.375	1	3	13.53	13.53	5975.50
11- 3-84	1340	307.569	1	3	13.53	13.53	5975.50
11- 6-84	1415	310.594	1	3	13.57	13.57	5975.46
11- 7-84	1410	311.590	1	3	13.53	13.53	5975.50
11-16-84	809	320.340	1	3	13.58	13.58	5975.45
11-19-84	853	323.370	1	3	13.65	13.65	5975.38
11-21-84	725	325.309	1	3	13.65	13.65	5975.38
11-26-84	1549	330.659	1	3	13.73	13.73	5975.30
11-28-84	1027	332.435	1	3	13.71	13.71	5975.32
11-30-84	830	334.354	1	3	13.76	13.76	5975.27
12- 3-84	1255	337.538	1	3	13.81	13.81	5975.22
12- 5-84	1537	339.651	1	3	13.84	13.84	5975.19
12- 8-84	1330	342.563	1	3	13.88	13.88	5975.15
12-10-84	918	344.388	1	3	13.89	13.89	5975.14
12-12-84	1110	346.465	1	3	13.86	13.86	5975.17
1-29-85	1500	210.625	1	3	14.53	14.53	5974.50
1-31-85	910	212.382	1	3	14.60	14.60	5974.43
2- 2-85	925	183.392	1	3	14.67	14.67	5974.36
2- 4-85	1120	185.472	1	3	14.73	14.73	5974.30
2- 6-85	930	187.396	1	3	14.70	14.70	5974.33
2-11-85	935	192.399	1	3	14.83	14.83	5974.20
2-13-85	1155	194.497	1	3	14.93	14.93	5974.10
2-15-85	840	196.361	1	3	14.94	14.94	5974.09

WATER-LEVEL DATA FOR TEST WELL: TW-14

MEASURING POINT (MP)
1 MP ELEVATION = 5989.16 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-20-84	925	263.392	1	3	11.91	11.91	5977.25
9-20-84	1005	263.420	1	3	11.91	11.91	5977.25
9-21-84	758	264.332	1	3	11.83	11.83	5977.33
9-22-84	900	265.375	1	3	11.88	11.88	5977.28
9-24-84	1710	267.715	1	3	11.78	11.78	5977.38
9-25-84	1100	268.458	1	3	11.79	11.79	5977.37
10- 3-84	905	276.378	1	3	11.81	11.81	5977.35
10- 8-84	930	281.396	1	3	11.86	11.86	5977.30
10-11-84	830	284.354	1	3	11.88	11.88	5977.28
10-15-84	1115	288.469	1	3	11.81	11.81	5977.35
10-18-84	1425	291.601	1	3	11.84	11.84	5977.32
10-22-84	1000	295.417	1	3	11.86	11.86	5977.30
10-25-84	1055	298.455	1	3	11.88	11.88	5977.28
10-27-84	1345	300.573	1	3	11.88	11.88	5977.28
10-29-84	820	302.347	1	3	11.89	11.89	5977.27
11- 1-84	900	305.375	1	3	11.93	11.93	5977.23
11- 3-84	1340	307.569	1	3	11.88	11.88	5977.28
11- 6-84	1415	310.594	1	3	11.86	11.86	5977.30
11- 7-84	1410	311.590	1	3	11.88	11.88	5977.28
11-16-84	810	320.340	1	3	11.91	11.91	5977.25
11-19-84	853	323.370	1	3	11.96	11.96	5977.20
11-21-84	725	325.309	1	3	11.99	11.99	5977.17
11-26-84	1549	330.659	1	3	12.07	12.07	5977.09
11-28-84	1027	332.435	1	3	12.06	12.06	5977.10
11-30-84	830	334.354	1	3	12.11	12.11	5977.05
12- 3-84	1255	337.538	1	3	12.15	12.15	5977.01
12- 5-84	1537	339.651	1	3	12.22	12.22	5976.94
12- 8-84	1330	342.563	1	3	12.17	12.17	5976.99
12-10-84	918	344.388	1	3	12.29	12.29	5976.87
12-12-84	1110	346.465	1	3	12.27	12.27	5976.89
1-29-85	1500	210.625	1	3	12.93	12.93	5976.23
1-31-85	910	212.382	1	3	12.96	12.96	5976.20
2- 2-85	925	183.392	1	3	13.02	13.02	5976.14
2- 4-85	1120	185.472	1	3	13.09	13.09	5976.07
2- 6-85	930	187.396	1	3	13.06	13.06	5976.10
2-11-85	935	192.399	1	3	13.12	13.12	5976.04
2-13-85	1155	194.497	1	3	13.24	13.24	5975.92
2-15-85	840	196.361	1	3	13.25	13.25	5975.91

WATER-LEVEL DATA FOR TEST WELL: TW-15

MEASURING POINT (MP)
1 MP ELEVATION = 5989.13 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-21-84	821	264.348	1	3	14.63	14.63	5974.50
9-22-84	900	265.375	1	3	14.63	14.63	5974.50
9-24-84	1710	267.715	1	3	14.60	14.60	5974.53
9-25-84	1100	268.458	1	3	14.65	14.65	5974.48
10- 3-84	925	276.392	1	3	14.58	14.58	5974.55
10-11-84	830	284.354	1	3	14.58	14.58	5974.55
10-15-84	1115	288.469	1	3	14.57	14.57	5974.56
10-18-84	1425	291.601	1	3	14.60	14.60	5974.53
10-22-84	1000	295.417	1	3	14.65	14.65	5974.48
10-25-84	1055	298.455	1	3	14.66	14.66	5974.47
10-27-84	1345	300.573	1	3	14.63	14.63	5974.50
10-29-84	825	302.351	1	3	14.66	14.66	5974.47
11- 1-84	900	305.375	1	3	14.70	14.70	5974.43
11- 3-84	1340	307.569	1	3	14.65	14.65	5974.48
11- 6-84	1410	310.590	1	3	14.63	14.63	5974.50
11- 7-84	1500	311.625	1	3	14.65	14.65	5974.48
11-16-84	815	320.344	1	3	14.70	14.70	5974.43
11-19-84	855	323.372	1	3	14.75	14.75	5974.38
11-21-84	725	325.309	1	3	14.76	14.76	5974.37
11-26-84	1549	330.659	1	3	14.83	14.83	5974.30
11-28-84	1027	332.435	1	3	14.80	14.80	5974.33
11-30-84	830	334.354	1	3	14.86	14.86	5974.27
12- 3-84	1255	337.538	1	3	14.89	14.89	5974.24
12- 5-84	1537	339.651	1	3	14.96	14.96	5974.17
12- 8-84	1330	342.563	1	3	14.96	14.96	5974.17
12-10-84	918	344.388	1	3	14.98	14.98	5974.15
12-12-84	1110	346.465	1	3	14.93	14.93	5974.20
1-29-85	1500	210.625	1	3	15.65	15.65	5973.48
1-31-85	910	212.382	1	3	15.75	15.75	5973.38
2- 2-85	925	183.392	1	3	15.78	15.78	5973.35
2- 4-85	1120	185.472	1	3	16.01	16.01	5973.12
2- 6-85	930	187.396	1	3	15.81	15.81	5973.32
2-11-85	935	192.399	1	3	15.91	15.91	5973.22
2-13-85	1155	194.497	1	3	16.04	16.04	5973.09
2-15-85	840	196.361	1	3	16.06	16.06	5973.07

WATER-LEVEL DATA FOR TEST WELL: TW-16

MEASURING POINT (MP)
1 MP ELEVATION = 5999.30 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-25-84	1435	268.608	1	3	61.88	61.88	5937.42
9-25-84	1742	268.738	1	3	61.88	61.88	5937.42
9-26-84	725	269.309	1	3	61.88	61.88	5937.42
10- 1-84	1630	274.688	1	3	61.96	61.96	5937.34
10- 3-84	935	276.399	1	3	61.99	61.99	5937.31
10- 4-84	1310	277.549	1	3	61.96	61.96	5937.34
10- 5-84	820	278.347	1	3	61.99	61.99	5937.31
10- 8-84	915	281.385	1	3	62.07	62.07	5937.23
10- 9-84	905	282.378	1	3	62.02	62.02	5937.28
10-12-84	1445	285.615	1	3	62.07	62.07	5937.23
10-15-84	945	288.406	1	3	62.09	62.09	5937.21
10-17-84	1200	290.500	1	5	62.05	62.05	5937.25
10-19-84	1200	292.500	1	5	62.10	62.10	5937.20
10-22-84	1700	295.708	1	3	62.19	62.19	5937.11
10-25-84	1040	298.444	1	3	62.24	62.24	5937.06
10-27-84	1400	300.583	1	3	62.22	62.22	5937.08
10-29-84	845	302.365	1	3	62.25	62.25	5937.05
11- 1-84	930	305.396	1	3	62.30	62.30	5937.00
11- 3-84	1325	307.559	1	3	62.30	62.30	5937.00
11- 6-84	1430	310.604	1	3	62.32	62.32	5936.98
11- 8-84	845	312.365	1	3	62.34	62.34	5936.96
11-16-84	832	320.356	1	3	62.47	62.47	5936.83
11-19-84	914	323.385	1	3	62.53	62.53	5936.77
11-21-84	812	325.342	1	3	62.55	62.55	5936.75
11-26-84	1606	330.671	1	3	62.60	62.60	5936.70
11-28-84	1105	332.462	1	3	62.58	62.58	5936.72
11-30-84	850	334.368	1	3	62.63	62.63	5936.67
12- 3-84	1316	337.553	1	3	62.70	62.70	5936.60
12- 5-84	1606	339.671	1	3	62.74	62.74	5936.56
12- 8-84	1350	342.576	1	3	62.76	62.76	5936.54
12-10-84	942	344.404	1	3	62.76	62.76	5936.54
12-12-84	1118	346.471	1	3	62.74	62.74	5936.56
1-29-85	1255	210.538	1	3	63.39	63.39	5935.91
1-31-85	932	212.397	1	3	63.42	63.42	5935.88
2- 2-85	1255	183.538	1	3	63.42	63.42	5935.88
2- 4-85	1000	185.417	1	3	63.48	63.48	5935.82
2- 6-85	835	187.358	1	3	63.43	63.43	5935.87
2-11-85	905	192.378	1	3	63.52	63.52	5935.78
2-13-85	942	194.404	1	3	63.60	63.60	5935.70
2-15-85	925	196.392	1	3	63.61	63.61	5935.69

WATER-LEVEL DATA FOR TEST WELL: TW-17

MEASURING POINT (MP)
1 MP ELEVATION = 5999.22 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
9-25-84	1740	268.736	1	3	61.79	61.79	5937.43
9-26-84	720	269.306	1	3	61.83	61.83	5937.39
10- 1-84	1630	274.688	1	3	61.88	61.88	5937.34
10- 3-84	935	276.399	1	3	61.91	61.91	5937.31
10- 4-84	1310	277.549	1	3	61.89	61.89	5937.33
10- 5-84	820	278.347	1	3	61.92	61.92	5937.30
10- 8-84	915	281.385	1	3	62.00	62.00	5937.22
10-11-84	1200	284.500	1	5	61.99	61.99	5937.23
10-15-84	930	288.396	1	3	62.00	62.00	5937.22
10-17-84	1200	290.500	1	5	61.97	61.97	5937.25
10-19-84	1200	292.500	1	5	62.06	62.06	5937.16
10-22-84	1700	295.708	1	3	62.10	62.10	5937.12
10-25-84	1040	298.444	1	3	62.15	62.15	5937.07
10-27-84	1400	300.583	1	3	62.14	62.14	5937.08
10-29-84	840	302.361	1	3	62.17	62.17	5937.05
11- 1-84	930	305.396	1	3	62.23	62.23	5936.99
11- 3-84	1325	307.559	1	3	62.24	62.24	5936.98
11- 6-84	1430	310.604	1	3	62.24	62.24	5936.98
11- 8-84	845	312.365	1	3	62.27	62.27	5936.95
11-16-84	832	320.356	1	3	62.38	62.38	5936.84
11-19-84	914	323.385	1	3	62.45	62.45	5936.77
11-21-84	812	325.342	1	3	62.47	62.47	5936.75
11-26-84	1606	330.671	1	3	62.52	62.52	5936.70
11-28-84	1105	332.462	1	3	62.52	62.52	5936.70
11-30-84	850	334.368	1	3	62.56	62.56	5936.66
12- 3-84	1316	337.553	1	3	62.61	62.61	5936.61
12- 5-84	1606	339.671	1	3	62.66	62.66	5936.56
12- 8-84	1350	342.576	1	3	62.66	62.66	5936.56
12-10-84	942	344.404	1	3	62.70	62.70	5936.52
12-12-84	1118	346.471	1	3	62.68	62.68	5936.54
1-29-85	1255	210.538	1	3	63.29	63.29	5935.93
1-31-85	932	212.397	1	3	63.32	63.32	5935.90
2- 2-85	1255	183.538	1	3	63.32	63.32	5935.90
2- 4-85	1000	185.417	1	3	63.42	63.42	5935.80
2- 6-85	835	187.358	1	3	63.37	63.37	5935.85
2-11-85	905	192.378	1	3	63.45	63.45	5935.77
2-13-85	942	194.404	1	3	63.53	63.53	5935.69
2-15-85	925	196.392	1	3	63.56	63.56	5935.66

WATER-LEVEL DATA FOR TEST WELL: TW-18

MEASURING POINT (MP)
1 MP ELEVATION = 5997.77 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10- 1-84	1630	274.688	1	3	58.69	58.69	5939.08
10- 3-84	937	276.401	1	3	58.76	58.76	5939.01
10- 4-84	1625	277.684	1	3	58.73	58.73	5939.04
10- 5-84	815	278.344	1	3	58.74	58.74	5939.03
10- 7-84	1200	280.500	1	5	58.80	58.80	5938.97
10- 9-84	1200	282.500	1	5	58.77	58.77	5939.00
10-11-84	820	284.347	1	3	58.79	58.79	5938.98
10-12-84	1445	285.615	1	3	58.86	58.86	5938.91
10-15-84	1200	288.500	1	5	58.86	58.86	5938.91
10-18-84	1610	291.674	1	3	58.87	58.87	5938.90
10-22-84	1000	295.417	1	3	58.97	58.97	5938.80
10-25-84	1040	298.444	1	3	59.00	59.00	5938.77
10-27-84	1400	300.583	1	3	59.00	59.00	5938.77
10-29-84	845	302.365	1	3	59.04	59.04	5938.73
11- 1-84	930	305.396	1	3	58.99	58.99	5938.78
11- 3-84	1325	307.559	1	3	59.09	59.09	5938.68
11- 6-84	1425	310.601	1	3	59.12	59.12	5938.65
11- 8-84	845	312.365	1	3	59.12	59.12	5938.65
11-16-84	839	320.360	1	3	59.26	59.26	5938.51
11-19-84	914	323.385	1	3	59.35	59.35	5938.42
11-21-84	816	325.344	1	3	59.37	59.37	5938.40
11-26-84	1610	330.674	1	3	59.41	59.41	5938.36
11-28-84	1105	332.462	1	3	59.38	59.38	5938.39
11-30-84	850	334.368	1	3	59.43	59.43	5938.34
12- 3-84	1316	337.553	1	3	59.50	59.50	5938.27
12- 5-84	1606	339.671	1	3	59.58	59.58	5938.19
12- 8-84	1350	342.576	1	3	59.56	59.56	5938.21
12-10-84	942	344.404	1	3	59.56	59.56	5938.21
12-12-84	1118	346.471	1	3	59.55	59.55	5938.22
1-29-85	1255	210.538	1	3	60.24	60.24	5937.53
1-31-85	932	212.397	1	3	60.27	60.27	5937.50
2- 2-85	1255	183.538	1	3	60.27	60.27	5937.50
2- 4-85	1000	185.417	1	3	60.36	60.36	5937.41
2- 6-85	835	187.358	1	3	60.30	60.30	5937.47
2-11-85	905	192.378	1	3	60.40	60.40	5937.37
2-13-85	942	194.404	1	3	60.50	60.50	5937.27
2-15-85	925	196.392	1	3	60.51	60.51	5937.26

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW29
Laboratory Number:	75960
Date Sampled:	11-12-84

Field Measurements	
Temperature(C)	10
pH (standard units)	6.34
Eh (millivolts)	200
Conductivity (micromhos/cm)	875

Laboratory Measurements	
pH (standard units)	6.7
Conductivity (micromhos/cm)	1360
Total Alkalinity (mg of CaCO3/l)	705
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	828
Sodium Adsorption Ratio	0.46
Total Hardness (mg of CaCO3/l)	708
Ionic Strength	2.26E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.61E-04	4.57E-04	
Calcium (Ca)		155	7.73E+00	3.87E-03
Magnesium (Mg)		78	6.41E+00	3.21E-03
Sodium (Na)		28	1.22E+00	1.22E-03
Potassium (K)		6	1.53E-01	1.53E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.03	1.09E-03	5.46E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		268	1.56E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	859	1.41E+01	1.41E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	21	5.92E-01	5.92E-04
Fluoride (F)	0.29	1.53E-02	1.53E-05
Nitrate + Nitrite (NOX)	23.09	4.28E-01	4.28E-04
Sulfate (SO4)	11	2.29E-01	1.15E-04
Dissolved Silica (H4SiO4)	79.0		8.22E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	994	1.53E+01	

Dissolved Solid Ratio	1.52
Cation-Anion Balance	0.68%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW30
Laboratory Number:	76011
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	13
pH (standard units)	6.59
Eh (millivolts)	110
Conductivity (micromhos/cm)	1530

Laboratory Measurements	
pH (standard units)	7.1
Conductivity (micromhos/cm)	2240
Total Alkalinity (mg of CaCO3/1)	400
Total Acidity (mg of CaCO3/1)	NA
Total Dissolved Solids (mg/1)	1400
Sodium Adsorption Ratio	2.91
Total Hardness (mg of CaCO3/1)	675
Ionic Strength	3.16E-02

Cations	mg/1	meq/1	moles/1
Hydrogen (H)	2.59E-04	2.57E-04	
Calcium (Ca)	130	6.49E+00	3.24E-03
Magnesium (Mg)	85	6.99E+00	3.50E-03
Sodium (Na)	174	7.57E+00	7.57E-03
Potassium (K)	11	2.81E-01	2.81E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	0.07		1.37E-06
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	1.2	6.65E-02	6.65E-05
Total	401	2.14E+01	

Anions	mg/1	meq/1	moles/1
Bicarbonate(HCO3)	488	7.99E+00	7.99E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	141	3.98E+00	3.98E-03
Fluoride (F)	2.38	1.25E-01	1.25E-04
Nitrate + Nitrite (NOX)	5.8	1.07E-01	1.07E-04
Sulfate (SO4)	389	8.10E+00	4.05E-03
Dissolved Silica (H4SiO4)	112.9		1.17E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1139	2.03E+01	

Dissolved Solid Ratio	1.10
Cation-Anion Balance	2.63%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW31
Laboratory Number:	76420
Date Sampled:	12-14-84

Field Measurements

Temperature(C)	8
pH (standard units)	8.02
Eh (millivolts)	-18
Conductivity (micromhos/cm)	300

Laboratory Measurements

pH (standard units)	7.3
Conductivity (micromhos/cm)	440
Total Alkalinity (mg of CaCO3/l)	131
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	274
Sodium Adsorption Ratio	0.6
Total Hardness (mg of CaCO3/l)	169
Ionic Strength	6.45E-03

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		9.63E-06	9.55E-06	
Calcium (Ca)		38	1.90E+00	9.48E-04
Magnesium (Mg)		18	1.48E+00	7.40E-04
Sodium (Na)		18	7.83E-01	7.83E-04
Potassium (K)		9	2.30E-01	2.30E-04
Arsenic (As)		0.007		9.34E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		0.56	2.51E-02	1.00E-05
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.04	1.46E-03	7.28E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.12		2.36E-06
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)			0.00E+00	0.00E+00
Total		84	4.42E+00	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	160	2.62E+00	2.62E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	18	5.08E-01	5.08E-04
Fluoride (F)	0.42	2.21E-02	2.21E-05
Nitrate + Nitrite (NOX)	13.26	2.46E-01	2.46E-04
Sulfate (SO4)	40	8.33E-01	4.16E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
(SiO4)			
Total	231	4.23E+00	

Dissolved Solid Ratio	1.15
Cation-Anion Balance	2.23%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW32
Laboratory Number:	76421
Date Sampled:	12-14-84

Field Measurements	
Temperature(C)	9.5
pH (standard units)	11.17
Eh (millivolts)	-85
Conductivity (micromhos/cm)	1000

Laboratory Measurements	
pH (standard units)	11
Conductivity (micromhos/cm)	1320
Total Alkalinity (mg of CaCO3/l)	352
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	440
Sodium Adsorption Ratio	0.51
Total Hardness (mg of CaCO3/l)	359
Ionic Strength	1.26E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		6.81E-09	6.76E-09	
Calcium (Ca)		142	7.09E+00	3.54E-03
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)		22	9.57E-01	9.57E-04
Potassium (K)		27	6.91E-01	6.91E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.03		5.89E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)			0.00E+00	0.00E+00
Total		192	8.82E+00	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	429	7.03E+00	7.03E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	18	5.08E-01	5.08E-04
Fluoride (F)	0.26	1.37E-02	1.37E-05
Nitrate + Nitrite (NOX)	6.9	1.28E-01	1.28E-04
Sulfate (SO4)	36	7.50E-01	3.75E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
(SiO4)			
Total	490	8.43E+00	

Dissolved Solid Ratio	1.55
Cation-Anion Balance	2.26%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW33
Laboratory Number:	76422
Date Sampled:	12-14-84

Field Measurements

Temperature(C)	9.5
pH (standard units)	8.16
Eh (millivolts)	29
Conductivity (micromhos/cm)	500

Laboratory Measurements

pH (standard units)	7.4
Conductivity (micromhos/cm)	640
Total Alkalinity (mg of CaCO3/l)	253
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	431
Sodium Adsorption Ratio	0.37
Total Hardness (mg of CaCO3/l)	312
Ionic Strength	1.06E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		6.97E-06	6.92E-06	
Calcium (Ca)		69	3.44E+00	1.72E-03
Magnesium (Mg)		34	2.80E+00	1.40E-03
Sodium (Na)		15	6.52E-01	6.52E-04
Potassium (K)		4	1.02E-01	1.02E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)		0.02	7.69E-04	3.85E-07
Iron (Fe)		0.11	4.92E-03	1.97E-06
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.27		5.30E-06
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)			0.00E+00	0.00E+00
Total		122	7.00E+00	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	308	5.05E+00	5.05E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	20	5.64E-01	5.64E-04
Fluoride (F)	0.39	2.05E-02	2.05E-05
Nitrate + Nitrite (NOX)	5.78	1.07E-01	1.07E-04
Sulfate (SO4)	53	1.10E+00	5.52E-04
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
(SiO4)			
Total	388	6.85E+00	

Dissolved Solid Ratio	1.18
Cation-Anion Balance	1.10%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW34
Laboratory Number:	76423
Date Sampled:	12-14-85

Field Measurements	
Temperature(C)	7
pH (standard units)	6.48
Eh (millivolts)	22
Conductivity (micromhos/cm)	575

Laboratory Measurements	
pH (standard units)	7.6
Conductivity (micromhos/cm)	1100
Total Alkalinity (mg of CaCO3/l)	422
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	806
Sodium Adsorption Ratio	0.18
Total Hardness (mg of CaCO3/l)	590
Ionic Strength	1.91E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		3.34E-04	3.31E-04	
Calcium (Ca)		88	4.39E+00	2.20E-03
Magnesium (Mg)		90	7.40E+00	3.70E-03
Sodium (Na)		10	4.35E-01	4.35E-04
Potassium (K)		8	2.05E-01	2.05E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)		0.21	9.40E-03	3.76E-06
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.1	3.64E-03	1.82E-06
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)		0.02	6.12E-04	3.06E-07
Ammonium (NH4)			0.00E+00	0.00E+00
Total		196	1.24E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	514	8.43E+00	8.43E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	44	1.24E+00	1.24E-03
Fluoride (F)	0.46	2.42E-02	2.42E-05
Nitrate + Nitrite (NOX)	0.62	1.15E-02	1.15E-05
Sulfate (SO4)	100	2.08E+00	1.04E-03
Dissolved Silica (H4SiO4)			
(H3SiO4)			
(H2SiO4)			
(HSiO4)			
(SiO4)			
Total	659	1.18E+01	

Dissolved Solid Ratio	1.06
Cation-Anion Balance	2.72%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Hooper
Laboratory Number:	75931
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	11
pH (standard units)	5.91
Eh (millivolts)	58
Conductivity (micromhos/cm)	990

Laboratory Measurements	
pH (standard units)	6.3
Conductivity (micromhos/cm)	1420
Total Alkalinity (mg of CaCO3/l)	753
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	860
Sodium Adsorption Ratio	0.53
Total Hardness (mg of CaCO3/l)	726
Ionic Strength	2.41E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.24E-03	1.23E-03	
Calcium (Ca)	111	5.54E+00	2.77E-03
Magnesium (Mg)	109	8.96E+00	4.48E-03
Sodium (Na)	33	1.44E+00	1.44E-03
Potassium (K)	14	3.58E-01	3.58E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	0.02	7.69E-04	3.85E-07
Iron (Fe)	4.54	2.03E-01	8.13E-05
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.21	7.64E-03	3.82E-06
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.02		3.93E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	0.6	3.33E-02	3.33E-05
Total	272	1.65E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	918	1.50E+01	1.50E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	9	2.54E-01	2.54E-04
Fluoride (F)	0.4	2.11E-02	2.11E-05
Nitrate + Nitrite (NOX)	< 0.19	3.52E-03	3.52E-06
Sulfate (SO4)	35	7.29E-01	3.64E-04
Dissolved Silica (H4SiO4)	114.0		1.19E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1076	1.60E+01	

Dissolved Solid Ratio	1.57
Cation-Anion Balance	1.51%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Southwest
Laboratory Number:	75933
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	14
pH (standard units)	6.67
Eh (millivolts)	94
Conductivity (micromhos/cm)	1180

Laboratory Measurements	
pH (standard units)	6.8
Conductivity (micromhos/cm)	1660
Total Alkalinity (mg of CaCO3/l)	792
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1040
Sodium Adsorption Ratio	0.80
Total Hardness (mg of CaCO3/l)	893
Ionic Strength	3.08E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	2.16E-04	2.14E-04	
Calcium (Ca)	130	6.49E+00	3.24E-03
Magnesium (Mg)	138	1.13E+01	5.68E-03
Sodium (Na)	55	2.39E+00	2.39E-03
Potassium (K)	16	4.09E-01	4.09E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	0.007	1.25E-04	6.23E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	0.007		8.87E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.02		3.93E-07
Zinc (Zn)	0.07	2.14E-03	1.07E-06
Ammonium (NH4)	0.9	4.99E-02	4.99E-05
Total	340	2.07E+01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		965	1.58E+01	1.58E-02
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)		42	1.18E+00	1.18E-03
Fluoride (F)		1.26	6.63E-02	6.63E-05
Nitrate + Nitrite (NOX)		26.64	4.93E-01	4.93E-04
Sulfate (SO4)		134	2.79E+00	1.39E-03
Dissolved Silica	(H4SiO4)	97.9		1.02E-03
	(H3SiO4)	ERR	ERR	ERR
	(H2SiO4)	ERR	ERR	ERR
	(HSiO4)	ERR	ERR	ERR
	(SiO4)	ERR	ERR	ERR
Total		1267	2.04E+01	

Dissolved Solid Ratio	1.55
Cation-Anion Balance	0.82%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Dock
Laboratory Number:	75930
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	11
pH (standard units)	5.76
Eh (millivolts)	50
Conductivity (micromhos/cm)	1010

Laboratory Measurements	
pH (standard units)	6.2
Conductivity (micromhos/cm)	1522
Total Alkalinity (mg of CaCO3/l)	801
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	906
Sodium Adsorption Ratio	0.53
Total Hardness (mg of CaCO3/l)	750
Ionic Strength	2.56E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	1.75E-03	1.74E-03	
Calcium (Ca)	109	5.44E+00	2.72E-03
Magnesium (Mg)	116	9.54E+00	4.77E-03
Sodium (Na)	33	1.44E+00	1.44E-03
Potassium (K)	15	3.84E-01	3.84E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.02	7.69E-04	3.85E-07
Iron (Fe)	5.79	2.59E-01	1.04E-04
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	0.22	8.01E-03	4.00E-06
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.02		3.93E-07
Zinc (Zn)	< 0.02	6.12E-04	3.06E-07
Ammonium (NH4)	0.6	3.33E-02	3.33E-05
Total	280	1.71E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	976	1.60E+01	1.60E-02
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	24	6.77E-01	6.77E-04
Fluoride (F)	0.44	2.32E-02	2.32E-05
Nitrate + Nitrite (NOX)	0.58	1.07E-02	1.07E-05
Sulfate (SO4)	50	1.04E+00	5.21E-04
Dissolved Silica (H4SiO4)	121.1		1.26E-03
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1173	1.78E+01	

Dissolved Solid Ratio	1.60
Cation-Anion Balance	1.87%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Mormon
Laboratory Number:	75932
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	12
pH (standard units)	6.67
Eh (millivolts)	190
Conductivity (micromhos/cm)	1020

Laboratory Measurements	
pH (standard units)	7.0
Conductivity (micromhos/cm)	1490
Total Alkalinity (mg of CaCO3/1)	339
Total Acidity (mg of CaCO3/1)	NA
Total Dissolved Solids (mg/1)	922
Sodium Adsorption Ratio	1.26
Total Hardness (mg of CaCO3/1)	642
Ionic Strength	2.61E-02

Cations		mg/1	meq/1	moles/1
Hydrogen (H)		2.16E-04	2.14E-04	
Calcium (Ca)		127	6.34E+00	3.17E-03
Magnesium (Mg)		79	6.50E+00	3.25E-03
Sodium (Na)		73	3.18E+00	3.18E-03
Potassium (K)		27	6.91E-01	6.91E-04
Arsenic (As)		0.005		6.67E-08
Cadmium (Cd)		0.038	6.76E-04	3.38E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)		0.011		1.39E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.03		5.89E-07
Zinc (Zn)		0.3	9.18E-03	4.59E-06
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		307	1.67E+01	

Anions	mg/1	meq/1	moles/1
Bicarbonate(HCO3)	413	6.77E+00	6.77E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	112	3.16E+00	3.16E-03
Fluoride (F)	9.77	5.14E-01	5.14E-04
Nitrate + Nitrite (NOX)	17.27	3.20E-01	3.20E-04
Sulfate (SO4)	285	5.93E+00	2.97E-03
Dissolved Silica (H4SiO4)	76.0		7.91E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	913	1.67E+01	

Dissolved Solid Ratio	1.32
Cation-Anion Balance	0.14%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Calf
Laboratory Number:	75929
Date Sampled:	11-09-84

Field Measurements

Temperature(C)	11
pH (standard units)	6.67
Eh (millivolts)	180
Conductivity (micromhos/cm)	1010

Laboratory Measurements

pH (standard units)	7.0
Conductivity (micromhos/cm)	1490
Total Alkalinity (mg of CaCO3/l)	317
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1030
Sodium Adsorption Ratio	1.14
Total Hardness (mg of CaCO3/l)	651
Ionic Strength	2.66E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		2.16E-04	2.14E-04	
Calcium (Ca)		132	6.59E+00	3.29E-03
Magnesium (Mg)		78	6.41E+00	3.21E-03
Sodium (Na)		67	2.91E+00	2.91E-03
Potassium (K)		25	6.39E-01	6.39E-04
Arsenic (As)		0.006		8.01E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)		0.026		3.29E-07
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.03		5.89E-07
Zinc (Zn)		0.08	2.45E-03	1.22E-06
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		303	1.66E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	386	6.33E+00	6.33E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	91	2.57E+00	2.57E-03
Fluoride (F)	8.14	4.28E-01	4.28E-04
Nitrate + Nitrite (NOX)	29.91	5.54E-01	5.54E-04
Sulfate (SO4)	328	6.83E+00	3.41E-03
Dissolved Silica (H4SiO4)	71.5		7.44E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	915	1.67E+01	

Dissolved Solid Ratio	1.18
Cation-Anion Balance	0.35%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Effluent
Laboratory Number:	75928
Date Sampled:	11-09-84

Field Measurements	
Temperature(C)	18
pH (standard units)	7.26
Eh (millivolts)	53
Conductivity (micromhos/cm)	1120

Laboratory Measurements	
pH (standard units)	7.9
Conductivity (micromhos/cm)	1540
Total Alkalinity (mg of CaCO3/l)	398
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	872
Sodium Adsorption Ratio	1.72
Total Hardness (mg of CaCO3/l)	508
Ionic Strength	2.06E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		5.54E-05	5.50E-05	
Calcium (Ca)		116	5.79E+00	2.89E-03
Magnesium (Mg)		53	4.36E+00	2.18E-03
Sodium (Na)		89	3.87E+00	3.87E-03
Potassium (K)		11	2.81E-01	2.81E-04
Arsenic (As)		0.01		1.33E-07
Cadmium (Cd)		0.022	3.91E-04	1.96E-07
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)		0.006		7.60E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.05		9.82E-07
Zinc (Zn)		0.03	9.18E-04	4.59E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		270	1.43E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	485	7.95E+00	7.95E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	132	3.72E+00	3.72E-03
Fluoride (F)	0.69	3.63E-02	3.63E-05
Nitrate + Nitrite (NOX)	26.14	4.84E-01	4.84E-04
Sulfate (SO4)	110	2.29E+00	1.15E-03
Dissolved Silica (H4SiO4)	56.8		5.91E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	811	1.45E+01	

Dissolved Solid Ratio	1.24
Cation-Anion Balance	0.51%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Nelson
Laboratory Number:	75997
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	NA
pH (standard units)	NA
Eh (millivolts)	NA
Conductivity (micromhos/cm)	NA

Laboratory Measurements	
pH (standard units)	7.5
Conductivity (micromhos/cm)	695
Total Alkalinity (mg of CaCO3/l)	195
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	498
Sodium Adsorption Ratio	0.55
Total Hardness (mg of CaCO3/l)	300
Ionic Strength	1.08E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		NA	NA	
Calcium (Ca)		79	3.94E+00	1.97E-03
Magnesium (Mg)		25	2.06E+00	1.03E-03
Sodium (Na)		22	9.57E-01	9.57E-04
Potassium (K)		4	1.02E-01	1.02E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		1.21	4.40E-02	2.20E-05
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)		0.09	2.75E-03	1.38E-06
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		132	7.14E+00	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	238	3.90E+00	3.90E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	52	1.47E+00	1.47E-03
Fluoride (F)	0.13	6.84E-03	6.84E-06
Nitrate + Nitrite (NOX)	53.2	9.85E-01	9.85E-04
Sulfate (SO4)	48	9.99E-01	5.00E-04
Dissolved Silica (H4SiO4)	45.9		4.77E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	437	7.35E+00	

Dissolved Solid Ratio	1.14
Cation-Anion Balance	1.47%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	SWC
Laboratory Number:	75999
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	NA
pH (standard units)	NA
Eh (millivolts)	NA
Conductivity (micromhos/cm)	NA

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	2020
Total Alkalinity (mg of CaCO3/l)	416
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	1250
Sodium Adsorption Ratio	3.28
Total Hardness (mg of CaCO3/l)	564
Ionic Strength	3.04E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		NA	NA	
Calcium (Ca)		140	6.99E+00	3.49E-03
Magnesium (Mg)		52	4.28E+00	2.14E-03
Sodium (Na)		179	7.79E+00	7.79E-03
Potassium (K)		9	2.30E-01	2.30E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.02	8.95E-04	3.58E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)		0.03	1.09E-03	5.46E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.44		8.64E-06
Zinc (Zn)		0.27	8.26E-03	4.13E-06
Ammonium (NH4)		18.7	1.04E+00	1.04E-03
Total		400	2.03E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	507	8.31E+00	8.31E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	186	5.25E+00	5.25E-03
Fluoride (F)	0.29	1.53E-02	1.53E-05
Nitrate + Nitrite (NOX)	46	8.52E-01	8.52E-04
Sulfate (SO4)	379	7.89E+00	3.95E-03
Dissolved Silica (H4SiO4)	35.9		3.73E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	1154	2.23E+01	

Dissolved Solid Ratio	1.24
Cation-Anion Balance	4.66%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Lewis
Laboratory Number:	76000
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	NA
pH (standard units)	NA
Eh (millivolts)	NA
Conductivity (micromhos/cm)	NA

Laboratory Measurements	
pH (standard units)	7.4
Conductivity (micromhos/cm)	1140
Total Alkalinity (mg of CaCO3/l)	417
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	792
Sodium Adsorption Ratio	0.97
Total Hardness (mg of CaCO3/l)	542
Ionic Strength	1.98E-02

Cations	mg/l	meq/l	moles/l
Hydrogen (H)	NA	NA	
Calcium (Ca)	118	5.89E+00	2.94E-03
Magnesium (Mg)	60	4.93E+00	2.47E-03
Sodium (Na)	52	2.26E+00	2.26E-03
Potassium (K)	8	2.05E-01	2.05E-04
Arsenic (As)	< 0.005		6.67E-08
Cadmium (Cd)	< 0.005	8.90E-05	4.45E-08
Chromium (Cr)	< 0.005	1.92E-04	9.62E-08
Iron (Fe)	< 0.05	2.24E-03	8.95E-07
Lead (Pb)	< 0.02	1.93E-04	9.65E-08
Manganese (Mn)	< 0.02	7.28E-04	3.64E-07
Selenium (Se)	< 0.005		6.33E-08
Silver (Ag)	< 0.02	1.85E-04	1.85E-07
Vanadium (V)	< 0.05		9.82E-07
Zinc (Zn)	0.06	1.84E-03	9.18E-07
Ammonium (NH4)	1.6	8.87E-02	8.87E-05
Total	240	1.34E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	508	8.33E+00	8.33E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	55	1.55E+00	1.55E-03
Fluoride (F)	0.35	1.84E-02	1.84E-05
Nitrate + Nitrite (NOX)	35.77	6.62E-01	6.62E-04
Sulfate (SO4)	120	2.50E+00	1.25E-03
Dissolved Silica (H4SiO4)	51		5.31E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	770	1.31E+01	

Dissolved Solid Ratio	1.28
Cation-Anion Balance	1.22%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	SWG
Laboratory Number:	75998
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	NA
pH (standard units)	NA
Eh (millivolts)	NA
Conductivity (micromhos/cm)	NA

Laboratory Measurements	
pH (standard units)	7.3
Conductivity (micromhos/cm)	1370
Total Alkalinity (mg of CaCO3/l)	311
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	980
Sodium Adsorption Ratio	1.03
Total Hardness (mg of CaCO3/l)	604
Ionic Strength	2.41E-02

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		NA	NA	
Calcium (Ca)		123	6.14E+00	3.07E-03
Magnesium (Mg)		72	5.92E+00	2.96E-03
Sodium (Na)		58	2.52E+00	2.52E-03
Potassium (K)		23	5.88E-01	5.88E-04
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.06		1.18E-06
Zinc (Zn)		0.05	1.53E-03	7.65E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		277	1.52E+01	

Anions	mg/l	meq/l	moles/l
Bicarbonate(HCO3)	379	6.21E+00	6.21E-03
Carbonate (CO3)	ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)	ERR		ERR
Hydroxide (OH)	ERR	ERR	ERR
Chloride (Cl)	81	2.28E+00	2.28E-03
Fluoride (F)	6.2	3.26E-01	3.26E-04
Nitrate + Nitrite (NOX)	28.76	5.32E-01	5.32E-04
Sulfate (SO4)	277	5.77E+00	2.88E-03
Dissolved Silica (H4SiO4)	69.5		7.23E-04
(H3SiO4)	ERR	ERR	ERR
(H2SiO4)	ERR	ERR	ERR
(HSiO4)	ERR	ERR	ERR
(SiO4)	ERR	ERR	ERR
Total	842	1.51E+01	

Dissolved Solid Ratio	1.14
Cation-Anion Balance	0.28%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Lab 1
Laboratory Number:	76004
Date Sampled:	11-14-84

Field Measurements	
Temperature(C)	23
pH (standard units)	8.34
Eh (millivolts)	40
Conductivity (micromhos/cm)	18

Laboratory Measurements	
pH (standard units)	6.0
Conductivity (micromhos/cm)	9
Total Alkalinity (mg of CaCO3/l)	6
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	8
Sodium Adsorption Ratio	0.67
Total Hardness (mg of CaCO3/l)	7
Ionic Strength	<3.37E-04

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.61E-06	4.57E-06	
Calcium (Ca)	<	1	4.99E-02	2.50E-05
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)		4	1.74E-01	1.74E-04
Potassium (K)	<	1	2.56E-02	2.56E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.04		7.85E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		8	3.70E-01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		7	1.20E-01	1.20E-04
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)	<	1	2.82E-02	2.82E-05
Fluoride (F)	<	0.1	5.26E-03	5.26E-06
Nitrate + Nitrite (NOX)		0.46	8.52E-03	8.52E-06
Sulfate (SO4)	<	1	2.08E-02	1.04E-05
Dissolved Silica (H4SiO4)	<	0.3		3.12E-06
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		10	1.83E-01	

Dissolved Solid Ratio	2.25
Cation-Anion Balance	33.87%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	Lab 2
Laboratory Number:	76005
Date Sampled:	11-14-84

Field Measurements		
Temperature(C)		23
pH (standard units)		8.34
Eh (millivolts)		40
Conductivity (micromhos/cm)		18

Laboratory Measurements		
pH (standard units)		4.7
Conductivity (micromhos/cm)		5
Total Alkalinity (mg of CaCO3/l)	<	1
Total Acidity (mg of CaCO3/l)		NA
Total Dissolved Solids (mg/l)		9
Sodium Adsorption Ratio		0.51
Total Hardness (mg of CaCO3/l)		7
Ionic Strength	<	2.64E-04

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		4.61E-06	4.57E-06	
Calcium (Ca)	<	1	4.99E-02	2.50E-05
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)		3	1.30E-01	1.30E-04
Potassium (K)	<	1	2.56E-02	2.56E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)	<	0.02		3.93E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		7	3.26E-01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)	<	1	2.00E-02	2.00E-05
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)	<	1	2.82E-02	2.82E-05
Fluoride (F)	<	0.1	5.26E-03	5.26E-06
Nitrate + Nitrite (NOX)		0.31	5.74E-03	5.74E-06
Sulfate (SO4)	<	1	2.08E-02	1.04E-05
Dissolved Silica (H4SiO4)	<	0.3		3.12E-06
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		4	8.00E-02	

Dissolved Solid Ratio	1.19
Cation-Anion Balance	60.62%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW7A
Laboratory Number:	75939
Date Sampled:	11-10-84

Field Measurements	
Temperature(C)	9
pH (standard units)	6.69
Eh (millivolts)	-36
Conductivity (micromhos/cm)	25

Laboratory Measurements	
pH (standard units)	5.2
Conductivity (micromhos/cm)	15
Total Alkalinity (mg of CaCO3/l)	2
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	30
Sodium Adsorption Ratio	0.16
Total Hardness (mg of CaCO3/l)	7
Ionic Strength	<2.30E-04

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		2.06E-04	2.04E-04	
Calcium (Ca)	<	1	4.99E-02	2.50E-05
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)	<	1	4.35E-02	4.35E-05
Potassium (K)	<	1	2.56E-02	2.56E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.04		7.85E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		5	2.39E-01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		2	4.00E-02	4.00E-05
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)	<	1	2.82E-02	2.82E-05
Fluoride (F)	<	0.1	5.26E-03	5.26E-06
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)	<	1	2.08E-02	1.04E-05
Dissolved Silica (H4SiO4)	<	0.3		3.12E-06
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		5	9.78E-02	

Dissolved Solid Ratio	0.33
Cation-Anion Balance	42.02%

Water Quality Analysis
Monsanto, Inc.
Soda Springs Plant

Identification:	TW13A
Laboratory Number:	75946
Date Sampled:	11-07-84

Field Measurements	
Temperature(C)	10
pH (standard units)	7.03
Eh (millivolts)	81
Conductivity (micromhos/cm)	590

Laboratory Measurements	
pH (standard units)	6.6
Conductivity (micromhos/cm)	10
Total Alkalinity (mg of CaCO3/l)	2
Total Acidity (mg of CaCO3/l)	NA
Total Dissolved Solids (mg/l)	22
Sodium Adsorption Ratio	0.16
Total Hardness (mg of CaCO3/l)	7
Ionic Strength	<2.26E-04

Cations		mg/l	meq/l	moles/l
Hydrogen (H)		9.41E-05	9.33E-05	
Calcium (Ca)	<	1	4.99E-02	2.50E-05
Magnesium (Mg)	<	1	8.22E-02	4.11E-05
Sodium (Na)	<	1	4.35E-02	4.35E-05
Potassium (K)	<	1	2.56E-02	2.56E-05
Arsenic (As)	<	0.005		6.67E-08
Cadmium (Cd)	<	0.005	8.90E-05	4.45E-08
Chromium (Cr)	<	0.02	7.69E-04	3.85E-07
Iron (Fe)	<	0.05	2.24E-03	8.95E-07
Lead (Pb)	<	0.02	1.93E-04	9.65E-08
Manganese (Mn)	<	0.02	7.28E-04	3.64E-07
Selenium (Se)	<	0.005		6.33E-08
Silver (Ag)	<	0.02	1.85E-04	1.85E-07
Vanadium (V)		0.03		5.89E-07
Zinc (Zn)	<	0.02	6.12E-04	3.06E-07
Ammonium (NH4)	<	0.6	3.33E-02	3.33E-05
Total		5	2.39E-01	

Anions		mg/l	meq/l	moles/l
Bicarbonate(HCO3)		2	3.28E-02	3.28E-05
Carbonate (CO3)		ERR	ERR	ERR
Dissolved Carbon Dioxide (H2CO2)		ERR		ERR
Hydroxide (OH)		ERR	ERR	ERR
Chloride (Cl)	<	1	2.82E-02	2.82E-05
Fluoride (F)	<	0.1	5.26E-03	5.26E-06
Nitrate + Nitrite (NOX)	<	0.19	3.52E-03	3.52E-06
Sulfate (SO4)	<	1	2.08E-02	1.04E-05
Dissolved Silica (H4SiO4)	<	0.3		3.12E-06
(H3SiO4)		ERR	ERR	ERR
(H2SiO4)		ERR	ERR	ERR
(HSiO4)		ERR	ERR	ERR
(SiO4)		ERR	ERR	ERR
Total		5	9.06E-02	

Dissolved Solid Ratio	0.43
Cation-Anion Balance	45.09%

WATER-LEVEL DATA FOR TEST WELL: TW-22

MEASURING POINT (MP)
1 MP ELEVATION = 5955.64 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10-16-84	1800	289.750	1	3	70.27	70.27	5885.37
10-17-84	850	290.368	1	3	70.08	70.08	5885.56
10-17-84	1700	290.708	1	3	70.04	70.04	5885.60
10-17-84	1740	290.736	1	3	70.21	70.21	5885.43
10-18-84	830	291.354	1	3	70.14	70.14	5885.50
10-22-84	945	295.406	1	3	70.18	70.18	5885.46
10-24-84	1520	297.639	1	3	70.14	70.14	5885.50
10-26-84	1200	299.500	1	5	70.08	70.08	5885.56
10-28-84	1200	301.500	1	5	70.09	70.09	5885.55
10-30-84	830	303.354	1	3	70.17	70.17	5885.47
11- 1-84	1200	305.500	1	5	70.21	70.21	5885.43
11- 2-84	1330	306.563	1	3	70.19	70.19	5885.45
11- 2-84	1515	306.635	1	3	70.34	70.34	5885.30
11- 3-84	1410	307.590	1	3	70.21	70.21	5885.43
11- 6-84	1455	310.622	1	3	70.21	70.21	5885.43
11- 8-84	1440	312.611	1	3	70.16	70.16	5885.48
11-16-84	1844	320.781	1	3	70.21	70.21	5885.43
11-19-84	925	323.392	1	3	70.22	70.22	5885.42
11-20-84	822	324.349	1	3	70.22	70.22	5885.42
11-22-84	1200	326.500	1	5	70.20	70.20	5885.44
11-24-84	1200	328.500	1	5	70.16	70.16	5885.48
11-26-84	1200	330.500	1	5	70.21	70.21	5885.43
11-27-84	1055	331.455	1	3	70.31	70.31	5885.33
11-29-84	1200	333.500	1	5	70.25	70.25	5885.39
12- 1-84	1200	335.500	1	5	70.22	70.22	5885.42
12- 3-84	1345	337.573	1	3	70.28	70.28	5885.36
12- 6-84	1200	340.500	1	5	70.35	70.35	5885.29
12- 8-84	1200	342.500	1	5	70.35	70.35	5885.29
12-10-84	1200	344.500	1	5	70.37	70.37	5885.27
12-11-84	1710	345.715	1	3	70.29	70.29	5885.35
12-14-84	1407	348.588	1	3	70.27	70.27	5885.37
1-29-85	1310	210.549	1	3	70.41	70.41	5885.23
1-31-85	940	212.403	1	3	70.63	70.63	5885.01
2- 2-85	1305	183.545	1	3	70.47	70.47	5885.17
2- 4-85	950	185.410	1	3	70.52	70.52	5885.12
2- 6-85	850	187.368	1	3	70.53	70.53	5885.11
2-11-85	1335	192.566	1	3	70.59	70.59	5885.05
2-13-85	1007	194.422	1	3	70.59	70.59	5885.05
2-15-85	935	196.399	1	3	70.60	70.60	5885.04

WATER-LEVEL DATA FOR TEST WELL: TW-23

MEASURING POINT (MP)
1 MP ELEVATION = 5955.41 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10-16-84	900	289.375	1	3	70.59	70.59	5884.82
10-17-84	900	290.375	1	3	70.60	70.60	5884.81
10-18-84	830	291.354	1	3	70.67	70.67	5884.74
10-18-84	1630	291.688	1	3	70.70	70.70	5884.71
10-20-84	1400	293.583	1	5	70.67	70.67	5884.74
10-22-84	1200	295.500	1	5	70.79	70.79	5884.62
10-24-84	800	297.333	1	5	70.75	70.75	5884.66
10-25-84	1010	298.424	1	3	70.80	70.80	5884.61
10-26-84	1400	299.583	1	5	70.60	70.60	5884.81
10-27-84	1200	300.500	1	5	70.68	70.68	5884.73
10-29-84	1200	302.500	1	5	70.71	70.71	5884.70
10-31-84	1200	304.500	1	5	70.77	70.77	5884.64
11- 1-84	945	305.406	1	3	70.86	70.86	5884.55
11- 2-84	1200	306.500	1	5	70.82	70.82	5884.59
11- 3-84	1200	307.500	1	5	70.86	70.86	5884.55
11- 4-84	1000	308.417	1	5	70.92	70.92	5884.49
11- 6-84	1455	310.622	1	3	70.86	70.86	5884.55
11- 8-84	1445	312.615	1	3	70.86	70.86	5884.55
11-16-84	844	320.364	1	3	71.04	71.04	5884.37
11-19-84	925	323.392	1	3	71.05	71.05	5884.36
11-21-84	823	325.349	1	3	71.06	71.06	5884.35
11-26-84	1618	330.679	1	3	71.11	71.11	5884.30
11-28-84	1116	332.469	1	3	71.09	71.09	5884.32
11-30-84	930	334.396	1	3	71.14	71.14	5884.27
12- 3-84	1345	337.573	1	3	71.18	71.18	5884.23
12- 5-84	1639	339.694	1	3	71.24	71.24	5884.17
12- 8-84	1400	342.583	1	3	71.29	71.29	5884.12
12-10-84	950	344.410	1	3	71.27	71.27	5884.14
12-12-84	1130	346.479	1	3	71.26	71.26	5884.15
12-14-84	1445	348.615	1	3	71.34	71.34	5884.07
1-29-85	1310	210.549	1	3	71.85	71.85	5883.56
1-31-85	940	212.403	1	3	71.88	71.88	5883.53
2- 2-85	1305	183.545	1	3	71.88	71.88	5883.53
2- 4-85	950	185.410	1	3	71.95	71.95	5883.46
2- 6-85	850	187.368	1	3	71.95	71.95	5883.46
2-11-85	1335	192.566	1	3	72.01	72.01	5883.40
2-13-85	1007	194.422	1	3	72.09	72.09	5883.32
2-15-85	935	196.399	1	3	72.08	72.08	5883.33

WATER-LEVEL DATA FOR TEST WELL: TW-24

MEASURING POINT (MP)
1 MP ELEVATION = 5955.39 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10-18-84	830	291.354	1	3	70.01	70.01	5885.38
10-22-84	945	295.406	1	3	70.00	70.00	5885.39
10-23-84	1120	296.472	1	3	70.01	70.01	5885.38
10-25-84	1200	298.500	1	5	69.96	69.96	5885.43
10-26-84	1200	299.500	1	5	69.93	69.93	5885.46
10-27-84	1200	300.500	1	5	69.96	69.96	5885.43
10-28-84	1200	301.500	1	5	69.97	69.97	5885.42
10-30-84	820	303.347	1	3	70.01	70.01	5885.38
11- 1-84	1200	305.500	1	5	70.05	70.05	5885.34
11- 2-84	1200	306.500	1	5	70.09	70.09	5885.30
11- 2-84	1400	306.583	1	5	70.34	70.34	5885.05
11- 2-84	1630	306.688	1	3	70.17	70.17	5885.22
11- 3-84	1320	307.556	1	3	70.03	70.03	5885.36
11- 6-84	1500	310.625	1	3	70.03	70.03	5885.36
11- 8-84	1415	312.594	1	3	70.01	70.01	5885.38
11-16-84	844	320.364	1	3	70.01	70.01	5885.38
11-19-84	925	323.392	1	3	70.04	70.04	5885.35
11-21-84	823	325.349	1	3	70.06	70.06	5885.33
11-26-84	1618	330.679	1	3	70.08	70.08	5885.31
11-28-84	1116	332.469	1	3	70.09	70.09	5885.30
11-30-84	930	334.396	1	3	70.08	70.08	5885.31
12- 3-84	1345	337.573	1	3	70.09	70.09	5885.30
12- 5-84	1635	339.691	1	3	70.11	70.11	5885.28
12- 8-84	1400	342.583	1	3	70.14	70.14	5885.25
12-10-84	950	344.410	1	3	70.16	70.16	5885.23
12-12-84	1130	346.479	1	3	70.11	70.11	5885.28
12-12-84	1425	346.601	1	3	70.11	70.11	5885.28
12-17-84	1440	351.611	1	3	70.18	70.18	5885.21
12-18-84	1430	352.604	1	3	70.21	70.21	5885.18
12-19-84	1120	353.472	1	3	70.21	70.21	5885.18
12-20-84	1000	354.417	1	5	70.21	70.21	5885.18
1-29-85	1310	210.549	1	3	70.21	70.21	5885.18
1-31-85	940	212.403	1	3	70.24	70.24	5885.15
2- 2-85	305	183.128	1	3	70.24	70.24	5885.15
2- 4-85	950	185.410	1	3	70.31	70.31	5885.08
2- 6-85	850	187.368	1	3	70.34	70.34	5885.05
2-11-85	1335	192.566	1	3	70.37	70.37	5885.02
2-13-85	1007	194.422	1	3	70.39	70.39	5885.00
2-15-85	935	196.399	1	3	70.39	70.39	5885.00

WATER-LEVEL DATA FOR TEST WELL: TW-25

MEASURING POINT (MP)
1 MP ELEVATION = 5999.00 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
11- 1-84	1000	305.417	1	3	92.45	92.45	5906.55
11- 3-84	700	307.292	1	3	92.57	92.57	5906.43
11- 3-84	1200	307.500	1	3	92.65	92.65	5906.35
11- 6-84	1510	310.632	1	3	92.60	92.60	5906.40
11-10-84	1545	314.656	1	3	92.52	92.52	5906.48
11-16-84	1110	320.465	1	3	92.53	92.53	5906.47
11-19-84	949	323.409	1	3	92.67	92.67	5906.33
11-19-84	1315	323.552	1	3	92.60	92.60	5906.40
11-20-84	1345	324.573	1	3	92.68	92.68	5906.32
11-21-84	920	325.389	1	3	92.62	92.62	5906.38
11-26-84	1655	330.705	1	3	92.60	92.60	5906.40
11-28-84	1145	332.490	1	3	92.60	92.60	5906.40
11-30-84	918	334.388	1	3	92.68	92.68	5906.32
11-30-84	1400	334.583	1	3	92.65	92.65	5906.35
12- 3-84	1333	337.565	1	3	92.76	92.76	5906.24
12- 8-84	1030	342.438	1	3	92.71	92.71	5906.29
12-12-84	1220	346.514	1	3	92.65	92.65	5906.35
12-17-84	1150	351.493	1	3	92.91	92.91	5906.09
1-29-85	1340	210.569	1	3	93.24	93.24	5905.76
1-31-85	1035	212.441	1	3	93.29	93.29	5905.71
2- 2-85	1315	183.552	1	3	93.14	93.14	5905.86
2- 4-85	940	185.403	1	3	93.19	93.19	5905.81
2- 6-85	900	187.375	1	3	93.19	93.19	5905.81
2-11-85	920	192.389	1	3	93.40	93.40	5905.60
2-13-85	1020	194.431	1	3	93.21	93.21	5905.79
2-15-85	1002	196.418	1	3	93.44	93.44	5905.56

WATER-LEVEL DATA FOR TEST WELL: TW-26

MEASURING POINT (MP)
1 MP ELEVATION = 5998.22 (FT MSL) : 4.5 CM ABOVE PERMANENT MP
2 MP ELEVATION = 5998.08 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10-27-84	1330	300.563	1	3	90.75	90.75	5907.47
10-29-84	1100	302.458	1	3	90.88	90.88	5907.34
10-30-84	1615	303.677	1	3	90.78	90.78	5907.44
10-31-84	900	304.375	1	3	91.34	91.34	5906.88
10-31-84	1720	304.722	1	3	91.24	91.24	5906.98
11- 1-84	1000	305.417	1	3	91.76	91.76	5906.46
11- 3-84	700	307.292	1	3	91.67	91.67	5906.55
11- 3-84	1200	307.500	1	3	91.70	91.70	5906.52
11- 6-84	1510	310.632	2	3	91.60	91.60	5906.48
11-11-84	1540	315.653	2	3	91.57	91.57	5906.51
11-16-84	1110	320.465	2	3	91.55	91.55	5906.53
11-19-84	949	323.409	2	3	91.71	91.71	5906.37
11-20-84	1340	324.569	2	3	91.65	91.65	5906.43
11-22-84	1200	326.500	2	5	91.72	91.72	5906.36
11-24-84	1200	328.500	2	5	91.50	91.50	5906.58
11-26-84	1200	330.500	2	5	91.67	91.67	5906.41
11-27-84	1105	331.462	2	3	91.65	91.65	5906.43
11-29-84	1200	333.500	2	5	91.70	91.70	5906.38
11-30-84	1530	334.646	2	3	91.66	91.66	5906.42
12- 2-84	1200	336.500	2	5	91.78	91.78	5906.30
12- 4-84	1435	338.608	2	5	91.73	91.73	5906.35
12- 6-84	1200	340.500	2	5	91.90	91.90	5906.18
12- 8-84	1200	342.500	2	5	91.78	91.78	5906.30
12-10-84	1200	344.500	2	5	91.76	91.76	5906.32
12-11-84	1730	345.729	2	3	91.78	91.78	5906.30
12-12-84	1200	346.500	2	5	91.65	91.65	5906.43
12-14-84	1200	348.500	2	5	91.89	91.89	5906.19
12-16-84	1200	350.500	2	5	91.74	91.74	5906.34
12-17-84	1145	351.490	2	3	91.91	91.91	5906.17
12-18-84	1150	352.493	2	3	91.91	91.91	5906.17
12-19-84	1110	353.465	2	3	91.94	91.94	5906.14
12-20-84	1000	354.417	2	5	91.90	91.90	5906.18
1-29-85	1340	210.569	2	3	92.22	92.22	5905.86
1-31-85	1035	212.441	2	3	92.30	92.30	5905.78
2- 2-85	1315	183.552	2	3	92.19	92.19	5905.89
2- 4-85	940	185.403	2	3	92.22	92.22	5905.86
2- 6-85	900	187.375	2	3	92.21	92.21	5905.87
2-11-85	920	192.389	2	3	92.39	92.39	5905.69
2-13-85	1020	194.431	2	3	92.49	92.49	5905.59
2-15-85	1002	196.418	2	3	92.42	92.42	5905.66

WATER-LEVEL DATA FOR TEST WELL: TW-27

MEASURING POINT (MP)
1 MP ELEVATION = 5998.10 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
10-31-84	900	304.375	1	3	88.38	88.38	5909.72
10-31-84	1720	304.722	1	3	88.45	88.45	5909.65
11- 1-84	1000	305.417	1	3	88.61	88.61	5909.49
11- 1-84	1530	305.646	1	3	88.61	88.61	5909.49
11- 3-84	700	307.292	1	3	88.58	88.58	5909.52
11- 3-84	1200	307.500	1	3	88.58	88.58	5909.52
11- 3-84	1620	307.681	1	3	88.61	88.61	5909.49
11- 6-84	1510	310.632	1	3	88.60	88.60	5909.50
11-11-84	1445	315.615	1	3	88.63	88.63	5909.47
11-16-84	1110	320.465	1	3	88.63	88.63	5909.47
11-19-84	949	323.409	1	3	88.76	88.76	5909.34
11-21-84	920	325.389	1	3	88.78	88.78	5909.32
11-26-84	1655	330.705	1	3	88.56	88.56	5909.54
11-28-84	1145	332.490	1	3	88.70	88.70	5909.40
11-30-84	918	334.388	1	3	88.76	88.76	5909.34
12- 3-84	1333	337.565	1	3	88.71	88.71	5909.39
12-10-84	1030	344.438	1	3	88.76	88.76	5909.34
12-12-84	1220	346.514	1	3	88.66	88.66	5909.44
12-17-84	1150	351.493	1	3	88.76	88.76	5909.34
1-29-85	1340	210.569	1	3	89.07	89.07	5909.03
1-31-85	1035	212.441	1	3	89.17	89.17	5908.93
2- 2-85	1315	183.552	1	3	89.00	89.00	5909.10
2- 4-85	940	185.403	1	3	89.00	89.00	5909.10
2- 6-85	900	187.375	1	3	89.11	89.11	5908.99
2-11-85	920	192.389	1	3	89.24	89.24	5908.86
2-13-85	1020	194.431	1	3	89.27	89.27	5908.83
2-15-85	1002	196.418	1	3	89.20	89.20	5908.90

WATER-LEVEL DATA FOR TEST WELL: TW-28

MEASURING POINT (MP)
1 MP ELEVATION = 5990.31 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
11- 6-84	1440	310.611	1	3	39.42	39.42	5950.89
11-11-84	1540	315.653	1	3	39.53	39.53	5950.78
11-16-84	825	320.351	1	3	39.62	39.62	5950.69
11-21-84	755	325.330	1	3	39.71	39.71	5950.60
11-23-84	1200	327.500	1	5	39.75	39.75	5950.56
11-25-84	1200	329.500	1	5	39.73	39.73	5950.58
11-27-84	1200	331.500	1	5	39.83	39.83	5950.48
11-28-84	1045	332.448	1	3	39.80	39.80	5950.51
11-30-84	1200	334.500	1	5	39.83	39.83	5950.48
12- 2-84	1200	336.500	1	5	39.88	39.88	5950.43
12- 4-84	1200	338.500	1	5	39.93	39.93	5950.38
12- 5-84	1358	339.582	1	5	39.98	39.98	5950.33
12- 7-84	1200	341.500	1	5	40.02	40.02	5950.29
12- 9-84	1200	343.500	1	5	40.04	40.04	5950.27
12-11-84	1200	345.500	1	5	40.00	40.00	5950.31
12-12-84	1030	346.438	1	3	40.02	40.02	5950.29
1-29-85	1300	210.542	1	3	40.91	40.91	5949.40
1-31-85	930	212.396	1	3	40.94	40.94	5949.37
2- 2-85	1250	183.535	1	3	40.94	40.94	5949.37
2- 4-85	1010	185.424	1	3	41.04	41.04	5949.27
2- 6-85	832	187.356	1	3	40.99	40.99	5949.32
2-11-85	903	192.377	1	3	41.08	41.08	5949.23
2-13-85	915	194.385	1	3	41.17	41.17	5949.14
2-15-85	917	196.387	1	3	41.19	41.19	5949.12

WATER-LEVEL DATA FOR TEST WELL: TW-29

MEASURING POINT (MP)
1 MP ELEVATION = 5990.30 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
11- 2-84	1230	306.521	1	3	39.37	39.37	5950.93
11- 3-84	1330	307.563	1	3	39.40	39.40	5950.90
11- 6-84	1435	310.608	1	3	39.43	39.43	5950.87
11-11-84	1510	315.632	1	3	39.53	39.53	5950.77
11-16-84	825	320.351	1	3	39.60	39.60	5950.70
11-19-84	906	323.379	1	3	39.68	39.68	5950.62
11-21-84	808	325.339	1	3	39.71	39.71	5950.59
11-26-84	1602	330.668	1	3	39.80	39.80	5950.50
11-28-84	1040	332.444	1	3	39.78	39.78	5950.52
11-30-84	841	334.362	1	3	39.83	39.83	5950.47
12- 3-84	1311	337.549	1	3	39.89	39.89	5950.41
12- 5-84	1400	339.583	1	3	39.98	39.98	5950.32
12- 8-84	1550	342.660	1	3	39.99	39.99	5950.31
12-10-84	938	344.401	1	3	40.03	40.03	5950.27
12-12-84	1030	346.438	1	3	39.99	39.99	5950.31
1-29-85	1300	210.542	1	3	40.89	40.89	5949.41
1-31-85	930	212.396	1	3	40.94	40.94	5949.36
2- 2-85	1250	183.535	1	3	40.94	40.94	5949.36
2- 4-85	1010	185.424	1	3	41.01	41.01	5949.29
2- 6-85	832	187.356	1	3	41.01	41.01	5949.29
2-11-85	903	192.377	1	3	41.08	41.08	5949.22
2-13-85	335	194.149	1	3	41.16	41.16	5949.14
2-15-85	917	196.387	1	3	41.17	41.17	5949.13

WATER-LEVEL DATA FOR TEST WELL: TW-30

MEASURING POINT (MP)
1 MP ELEVATION = 5993.38 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
11-16-84	1000	320.417	1	3	62.01	62.01	5931.37
11-17-84	1200	321.500	1	5	62.02	62.02	5931.36
11-18-84	1200	322.500	1	5	62.03	62.03	5931.35
11-19-84	1200	323.500	1	5	62.05	62.05	5931.33
11-21-84	932	325.397	1	3	62.04	62.04	5931.34
11-23-84	1200	327.500	1	5	62.01	62.01	5931.37
11-24-84	1200	328.500	1	5	61.99	61.99	5931.39
11-28-84	1135	332.483	1	3	62.04	62.04	5931.34
11-30-84	1200	334.500	1	5	62.07	62.07	5931.31
12- 2-84	1200	336.500	1	5	62.11	62.11	5931.27
12- 4-84	1800	338.750	1	5	62.13	62.13	5931.25
12- 5-84	1625	339.684	1	3	62.12	62.12	5931.26
12- 7-84	1200	341.500	1	5	62.15	62.15	5931.23
12- 9-84	1200	343.500	1	5	62.14	62.14	5931.24
12-11-84	1200	345.500	1	5	62.09	62.09	5931.29
12-12-84	1135	346.483	1	3	62.06	62.06	5931.32
12-13-84	1200	347.500	1	5	62.16	62.16	5931.22
12-14-84	1200	348.500	1	5	62.21	62.21	5931.17
12-17-84	953	351.412	1	3	62.20	62.20	5931.18
12-18-84	930	352.396	1	3	62.15	62.15	5931.23
12-19-84	840	353.361	1	3	62.15	62.15	5931.23
12-20-84	800	354.333	1	5	62.05	62.05	5931.33
1-29-85	1530	210.646	1	3	62.30	62.30	5931.08
1-30-85	1510	211.632	1	3	62.33	62.33	5931.05
2- 3-85	1200	184.500	1	5	62.40	62.40	5930.98
2- 6-85	915	187.385	1	3	62.37	62.37	5931.01
2- 8-85	1200	189.500	1	5	62.31	62.31	5931.07
2-10-85	1200	191.500	1	5	62.42	62.42	5930.96
2-12-85	1000	193.417	1	5	62.38	62.38	5931.00
2-13-85	1015	194.427	1	3	62.47	62.47	5930.91
2-15-85	955	196.413	1	3	62.40	62.40	5930.98

WATER-LEVEL DATA FOR TEST WELL: TW-31

MEASURING POINT (MP)
1 MP ELEVATION = 5976.23 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEVENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
12- 4-84	730	338.313	1	3	23.00	23.00	5953.23
12- 8-84	1250	342.535	1	3	23.46	23.46	5952.77
12- 9-84	1200	343.500	1	3	23.39	23.39	5952.84
12-10-84	835	344.358	1	3	23.29	23.29	5952.94
12-12-84	1100	346.458	1	3	23.06	23.06	5953.17
12-12-84	1445	346.615	1	3	23.06	23.06	5953.17
12-12-84	1605	346.670	1	3	23.22	23.22	5953.01
12-13-84	745	347.323	1	3	23.18	23.18	5953.05
1-29-85	1150	210.493	1	3	23.72	23.72	5952.51
1-30-85	1550	211.660	1	3	23.75	23.75	5952.48
2- 2-85	1200	183.500	1	5	23.83	23.83	5952.40
2- 4-85	1200	185.500	1	5	23.92	23.92	5952.31
2- 6-85	940	187.403	1	3	23.93	23.93	5952.30
2-11-85	1015	192.427	1	3	23.85	23.85	5952.38
2-13-85	915	194.385	1	3	24.24	24.24	5951.99
2-15-85	848	196.367	1	3	24.19	24.19	5952.04

WATER-LEVEL DATA FOR TEST WELL: TW-32

MEASURING POINT (MP)
1 MP ELEVATION = 5976.59 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEVENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
12- 9-84	1200	343.500	1	3	26.12	26.12	5950.47
12-10-84	835	344.358	1	3	26.12	26.12	5950.47
12-14-84	1625	348.684	1	3	25.59	25.59	5951.00
1-29-85	1150	210.493	1	3	25.82	25.82	5950.77
1-31-85	905	212.378	1	3	25.95	25.95	5950.64
2- 2-85	930	183.396	1	3	25.92	25.92	5950.67
2- 4-85	1130	185.479	1	3	26.12	26.12	5950.47
2- 6-85	935	187.399	1	3	26.08	26.08	5950.51
2- 8-85	1200	189.500	1	5	26.10	26.10	5950.49
2-12-85	1600	193.667	1	5	26.36	26.36	5950.23
2-13-85	915	194.385	1	3	26.36	26.36	5950.23
2-15-85	848	196.367	1	3	26.38	26.38	5950.21

WATER-LEVEL DATA FOR TEST WELL: TW-33

MEASURING POINT (MP)
1 MP ELEVATION = 5976.53 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEVENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
12- 9-84	1200	343.500	1	3	25.64	25.64	5950.89
12-10-84	835	344.358	1	3	25.49	25.49	5951.04
12-11-84	1100	345.458	1	3	24.54	24.54	5951.99
12-12-84	1500	346.625	1	3	24.61	24.61	5951.92
12-12-84	1630	346.688	1	3	24.77	24.77	5951.76
12-12-84	1730	346.729	1	5	25.19	25.19	5951.34
12-12-84	2000	346.833	1	5	24.75	24.75	5951.78
12-13-84	750	347.326	1	3	24.75	24.75	5951.78
12-13-84	945	347.406	1	3	24.83	24.83	5951.70
12-13-84	1200	347.500	1	5	24.79	24.79	5951.74
12-14-84	1445	348.615	1	3	24.57	24.57	5951.96
1-29-85	1150	210.493	1	3	25.00	25.00	5951.53
1-30-85	1035	211.441	1	3	25.10	25.10	5951.43
2- 4-85	1130	185.479	1	5	25.27	25.27	5951.26
2- 6-85	930	187.396	1	3	25.29	25.29	5951.24
2- 8-85	1200	189.500	1	3	25.20	25.20	5951.33
2-10-85	800	191.333	1	5	25.44	25.44	5951.09
2-12-85	1600	193.667	1	5	25.50	25.50	5951.03
2-13-85	915	194.385	1	3	25.59	25.59	5950.94
2-15-85	848	196.367	1	3	25.54	25.54	5950.99

WATER-LEVEL DATA FOR TEST WELL: TW-34

MEASURING POINT (MP)
1 MP ELEVATION = 5894.12 (FT MSL) : TOP OF 4 IN PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3
5 STEPHENS RECORDER CHART

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
12-14-84	1445	348.615	1	3	24.61	24.61	5869.51
12-15-84	1300	349.542	1	3	24.54	24.54	5869.58
12-15-84	1335	349.566	1	5	24.53	24.53	5869.59
12-15-84	1345	349.573	1	5	24.53	24.53	5869.59
12-15-84	1400	349.583	1	5	24.53	24.53	5869.59
12-15-84	1415	349.594	1	5	24.53	24.53	5869.59
12-15-84	1430	349.604	1	5	24.54	24.54	5869.58
12-15-84	1445	349.615	1	5	24.55	24.55	5869.57
12-15-84	1500	349.625	1	5	24.56	24.56	5869.56
12-15-84	1530	349.646	1	5	24.58	24.58	5869.54
12-15-84	1600	349.667	1	5	24.60	24.60	5869.52
12-15-84	1630	349.688	1	5	24.62	24.62	5869.50
12-15-84	1700	349.708	1	5	24.63	24.63	5869.49
12-15-84	1730	349.729	1	5	24.65	24.65	5869.47
12-15-84	1800	349.750	1	5	24.66	24.66	5869.46
12-15-84	1900	349.792	1	5	24.69	24.69	5869.43
12-15-84	2000	349.833	1	5	24.71	24.71	5869.41
12-15-84	2100	349.875	1	5	24.73	24.73	5869.39
12-15-84	2200	349.917	1	5	24.76	24.76	5869.36
12-15-84	2300	349.958	1	5	24.78	24.78	5869.34
12-15-84	2400	350.000	1	5	24.80	24.80	5869.32
12-16-84	100	350.042	1	5	24.81	24.81	5869.31
12-16-84	200	350.083	1	5	24.81	24.81	5869.31
12-16-84	300	350.125	1	5	24.82	24.82	5869.30
12-16-84	400	350.167	1	5	24.82	24.82	5869.30
12-16-84	500	350.208	1	5	24.83	24.83	5869.29
12-16-84	600	350.250	1	5	24.84	24.84	5869.28
12-16-84	700	350.292	1	5	24.85	24.85	5869.27
12-16-84	800	350.333	1	5	24.86	24.86	5869.26
12-16-84	900	350.375	1	5	24.86	24.86	5869.26
12-16-84	1000	350.417	1	5	24.87	24.87	5869.25
12-16-84	1100	350.458	1	3	24.90	24.90	5869.22
12-16-84	1200	350.500	1	5	24.90	24.90	5869.22
12-16-84	1220	350.514	1	5	24.90	24.90	5869.22
12-16-84	1230	350.521	1	5	24.90	24.90	5869.22
12-16-84	1300	350.542	1	5	24.89	24.89	5869.23
12-16-84	1315	350.552	1	5	24.88	24.88	5869.24
12-16-84	1330	350.563	1	5	24.87	24.87	5869.25
12-16-84	1345	350.573	1	5	24.87	24.87	5869.25
12-16-84	1400	350.583	1	5	24.86	24.86	5869.26
12-16-84	1430	350.604	1	5	24.85	24.85	5869.27
12-16-84	1500	350.625	1	5	24.84	24.84	5869.28
12-16-84	1530	350.646	1	5	24.83	24.83	5869.29
12-16-84	1600	350.667	1	5	24.82	24.82	5869.30

WATER-LEVEL DATA FOR TEST WELL: TW-35

MEASURING POINT (MP)
1 MP ELEVATION = 5898.08 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
2-13-85	1103	194.460	1	3	28.30	28.30	5869.78
2-14-85	1000	195.417	1	3	28.25	28.25	5869.83
2-14-85	1155	195.497	1	3	28.26	28.26	5869.82
2-15-85	1300	196.542	1	3	28.31	28.31	5869.77

WATER-LEVEL DATA FOR TEST WELL: TW-36

MEASURING POINT (MP)
1 MP ELEVATION = 5907.66 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
2- 2-85	1353	183.578	1	3	27.00	27.00	5880.66
2- 4-85	1230	185.521	1	3	27.43	27.43	5880.23
2- 6-85	1035	187.441	1	3	27.10	27.10	5880.56
2- 7-85	1015	188.427	1	3	27.10	27.10	5880.56
2-12-85	900	193.375	1	3	27.16	27.16	5880.50
2-13-85	1630	194.688	1	3	27.13	27.13	5880.53
2-15-85	1255	196.538	1	3	27.21	27.21	5880.45

WATER-LEVEL DATA FOR TEST WELL: TW-37

MEASURING POINT (MP)
1 MP ELEVATION = 5960.10 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
2- 6-85	840	187.361	1	3	68.91	68.91	5891.19
2-11-85	910	192.382	1	3	69.00	69.00	5891.10
2-12-85	1200	193.500	1	3	69.01	69.01	5891.09
2-13-85	1000	194.417	1	3	69.09	69.09	5891.01
2-15-85	942	196.404	1	3	69.11	69.11	5890.99

WATER-LEVEL DATA FOR TEST WELL: TW-38

MEASURING POINT (MP)
1 MP ELEVATION = 5973.89 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
2-11-85	930	192.396	1	3	87.89	87.89	5886.00
2-12-85	1015	193.427	1	3	87.88	87.88	5886.01
2-12-85	1115	193.469	1	3	87.86	87.86	5886.03
2-13-85	1140	194.486	1	3	87.86	87.86	5886.03
2-15-85	828	196.353	1	3	87.94	87.94	5885.95

WATER-LEVEL DATA FOR TEST WELL: TW-39

MEASURING POINT (MP)
1 MP ELEVATION = 5897.99 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
2-11-85	1110	192.465	1	3	28.81	28.81	5869.18
2-13-85	1103	194.460	1	3	28.90	28.90	5869.09
2-13-85	1210	194.507	1	3	28.94	28.94	5869.05
2-15-85	1300	196.542	1	3	28.97	28.97	5869.02

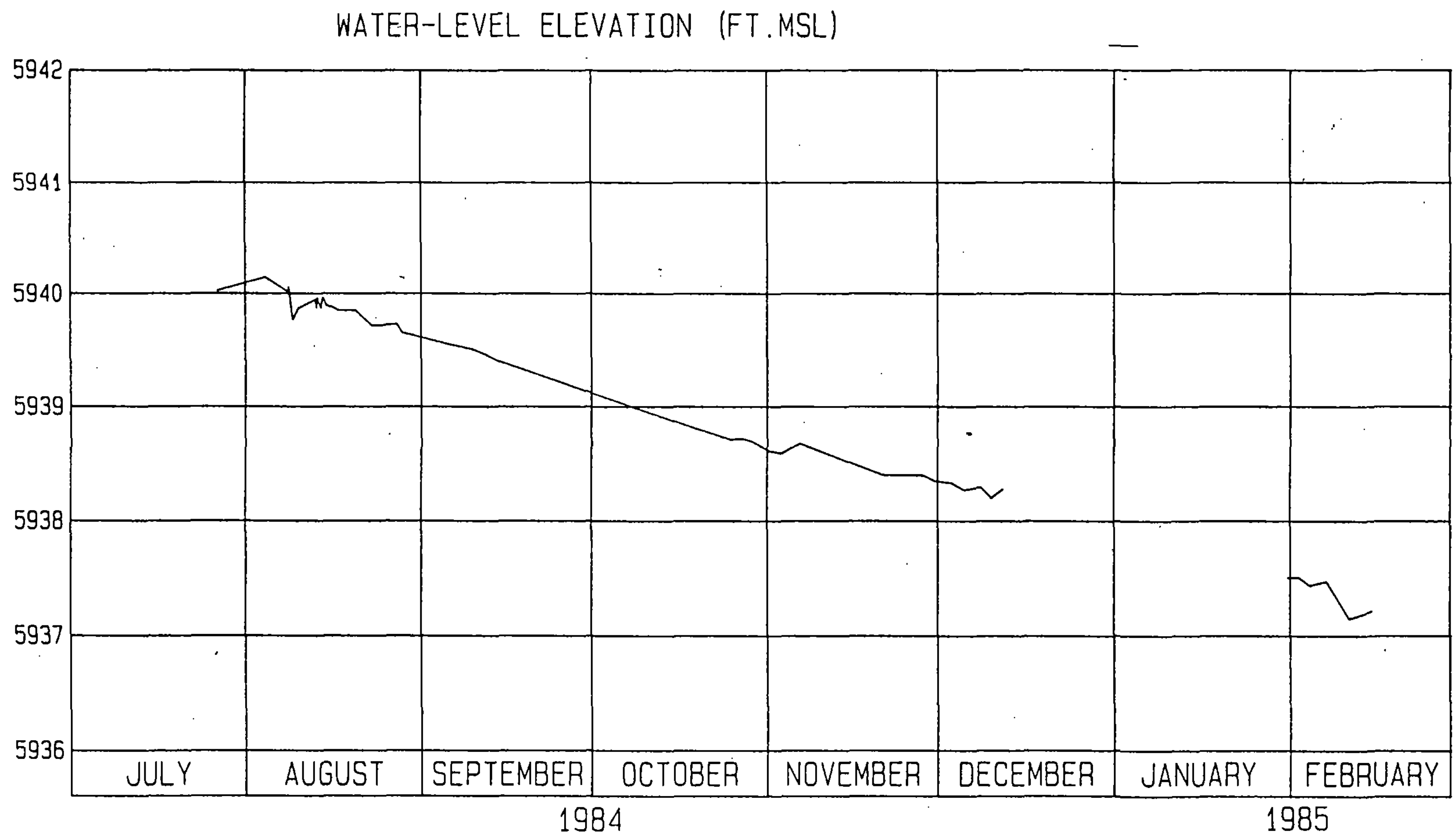
WATER-LEVEL DATA FOR TEST WELL: TW-40

MEASURING POINT (MP)
1 MP ELEVATION = 5990.87 (FT MSL) : TOP OF 4 IN. PVC CASING

MEASURING DEVICE (MD)
3 GOLDER ELECTRIC PROBE #3

DATE	TIME	FRAC. DAYS (DAYS)	MP	MD	MEAS. DEPTH (FT.BMP)	CORR. DEPTH (FT.BMP)	ELEV. (FT.MSL)
2-17-85	1510	198.632	1	3	84.64	84.64	5906.23

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED .... DATE Apr. '85



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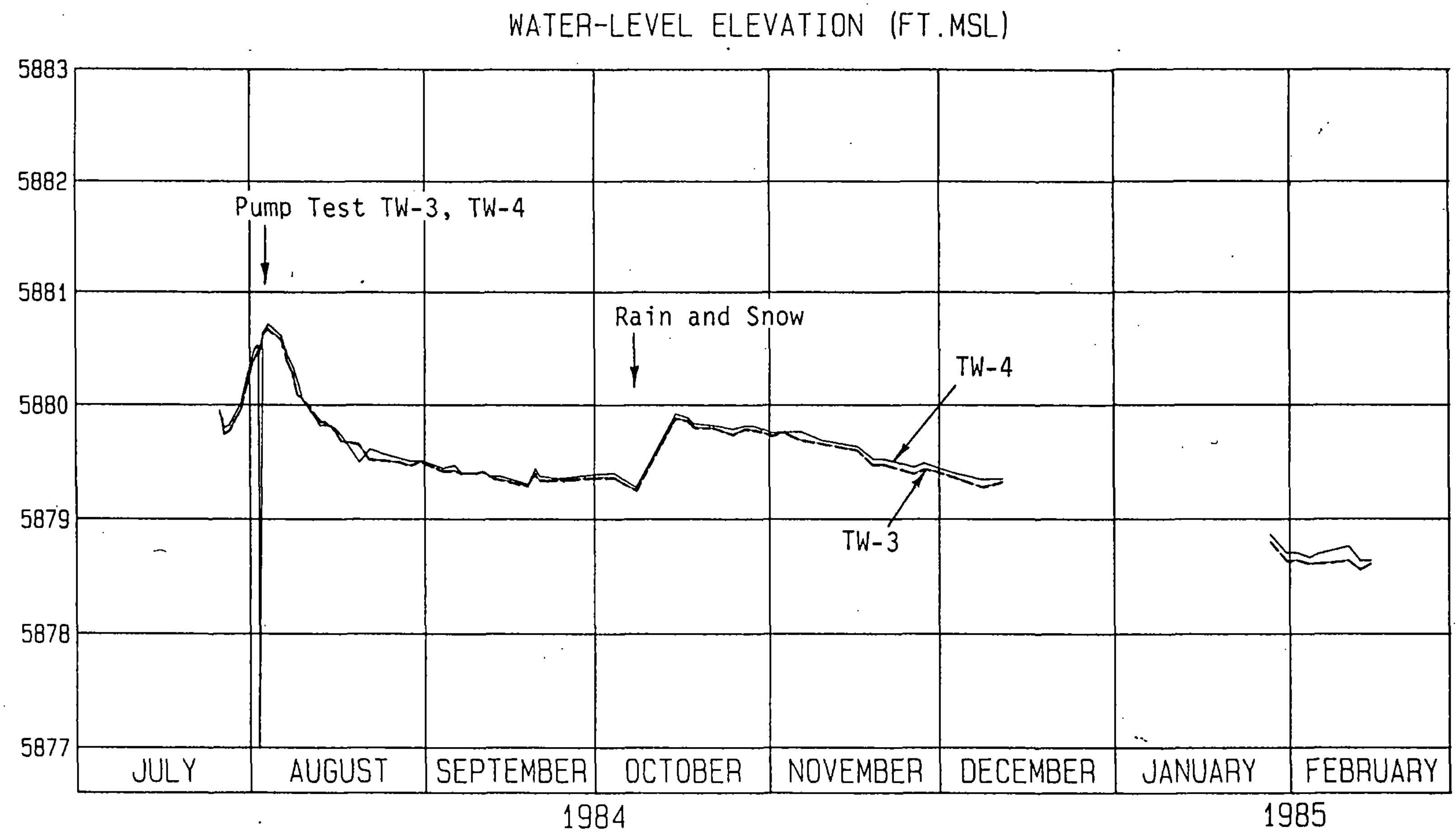
GROUND WATER HYDROGRAPH
MONSANTO TW-2

Figure C-1

PROJECT NO. 842-1543 DRAWN GA. REVIEWED ...... DATE Apr. '85

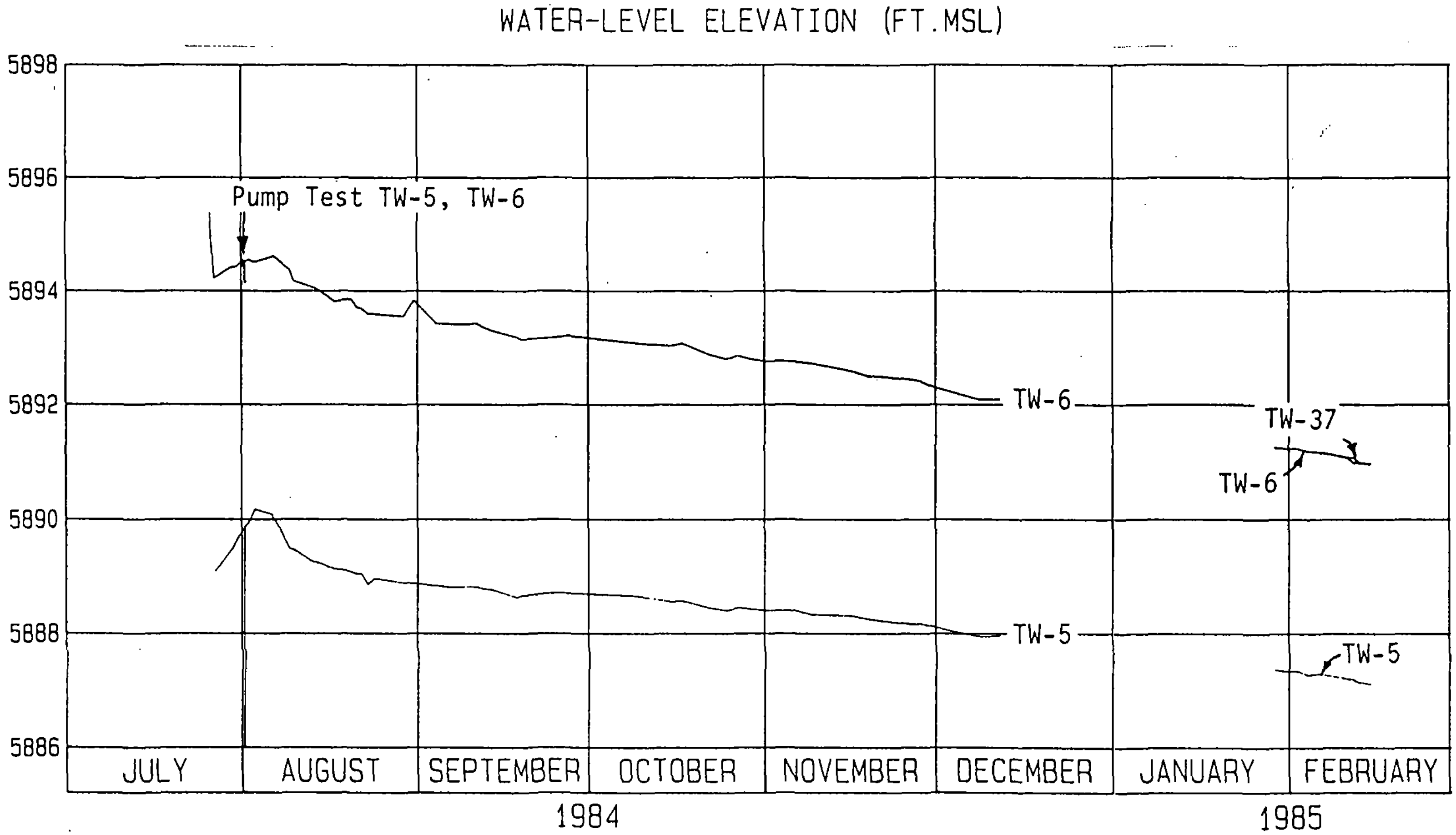


Golder Associates

GROUND WATER HYDROGRAPH
MONSANTO TW-3 TW-4

Figure C-2

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED .... DATE Apr. '85



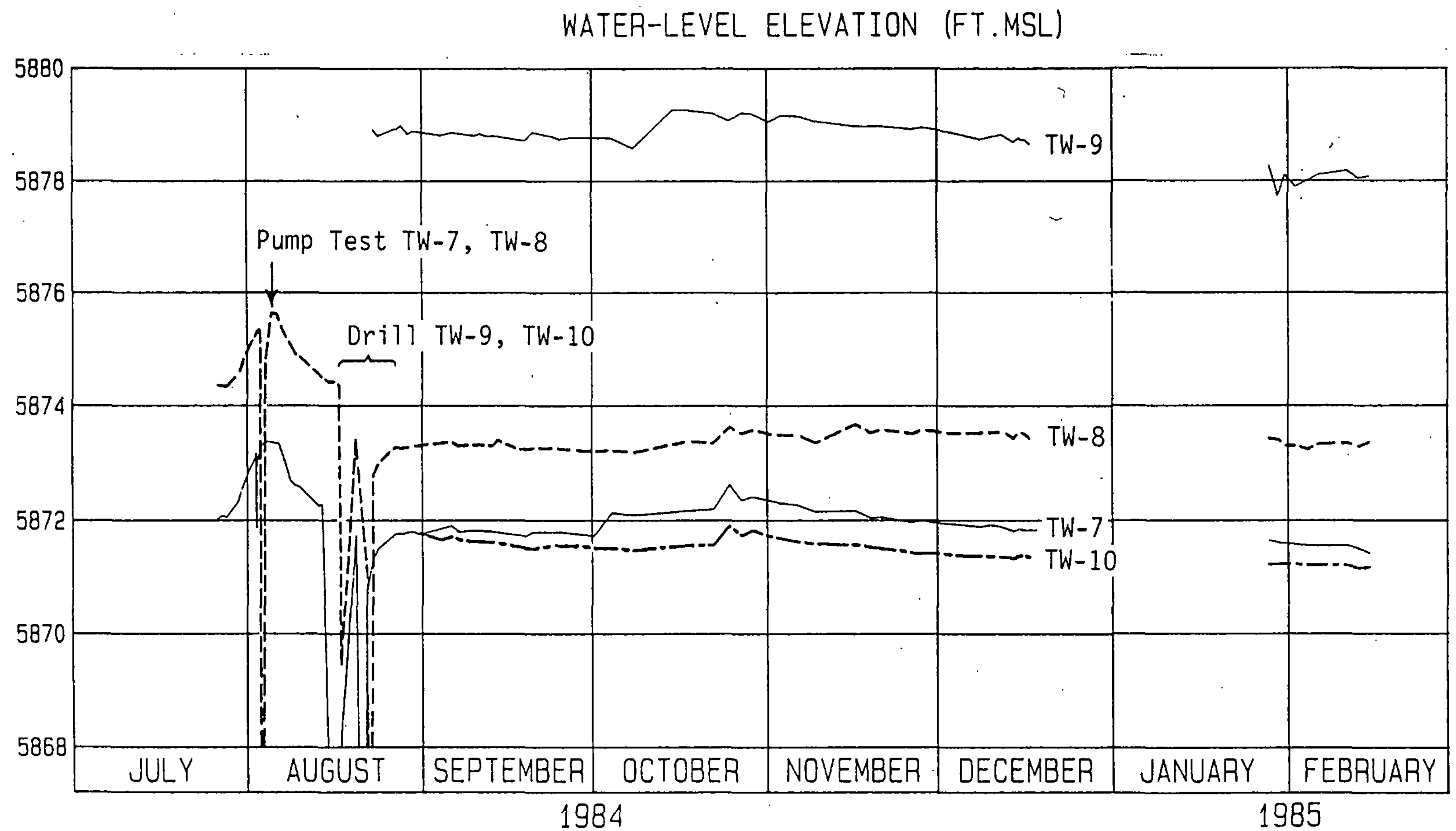
Note; TW-37 completed Feb. 6, 1985,
only limited data collected.

Golder Associates

GROUND WATER HYDROGRAPH
MONSANTO TW-5 TW-6 TW-37

Figure C-3

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED DATE Apr. '85

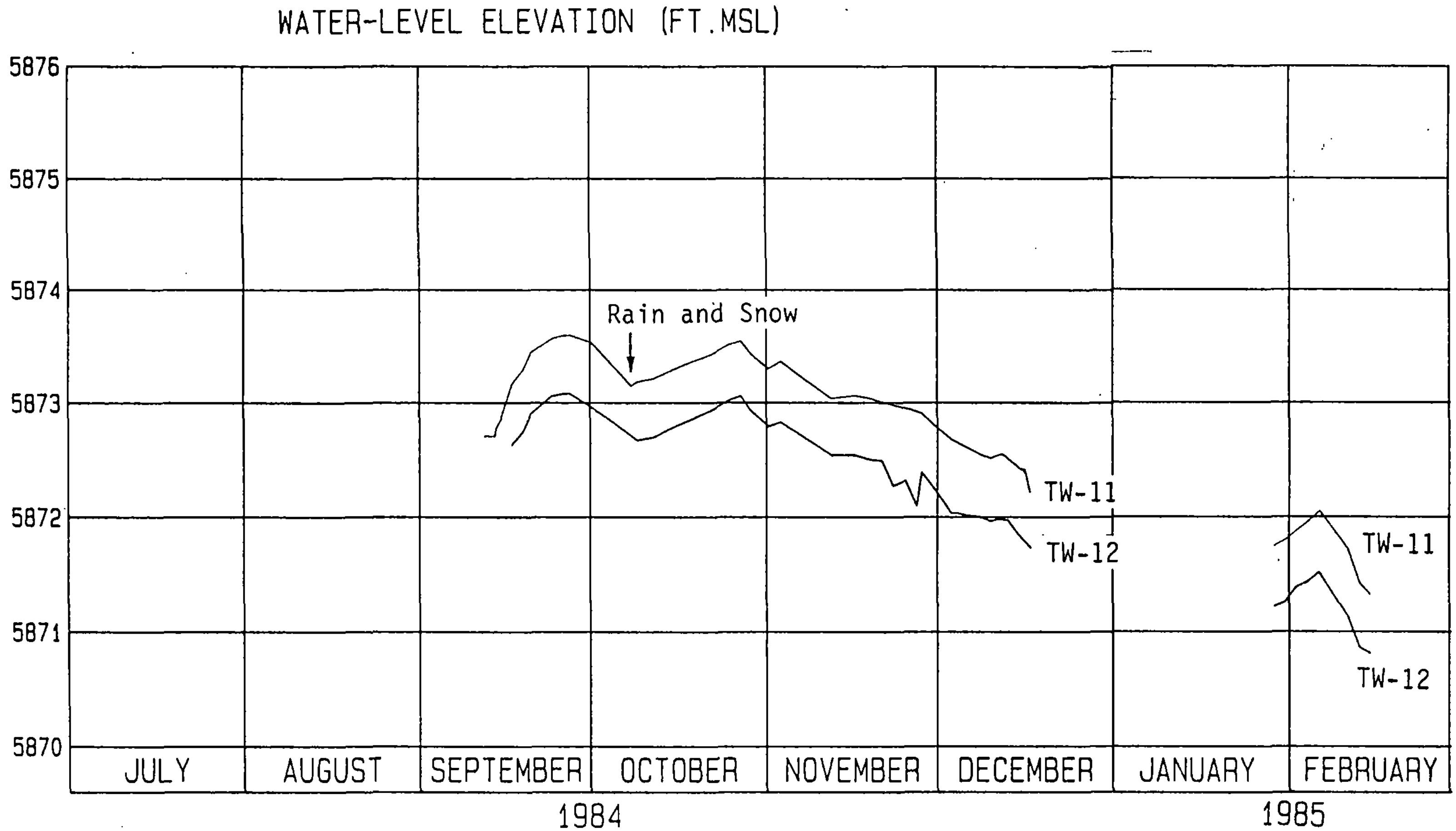


Golder Associates

GROUND WATER HYDROGRAPH
MONSANTO TW-7 TW-8 TW-9 -10

Figure C-4

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED .... DATE Apr. '85



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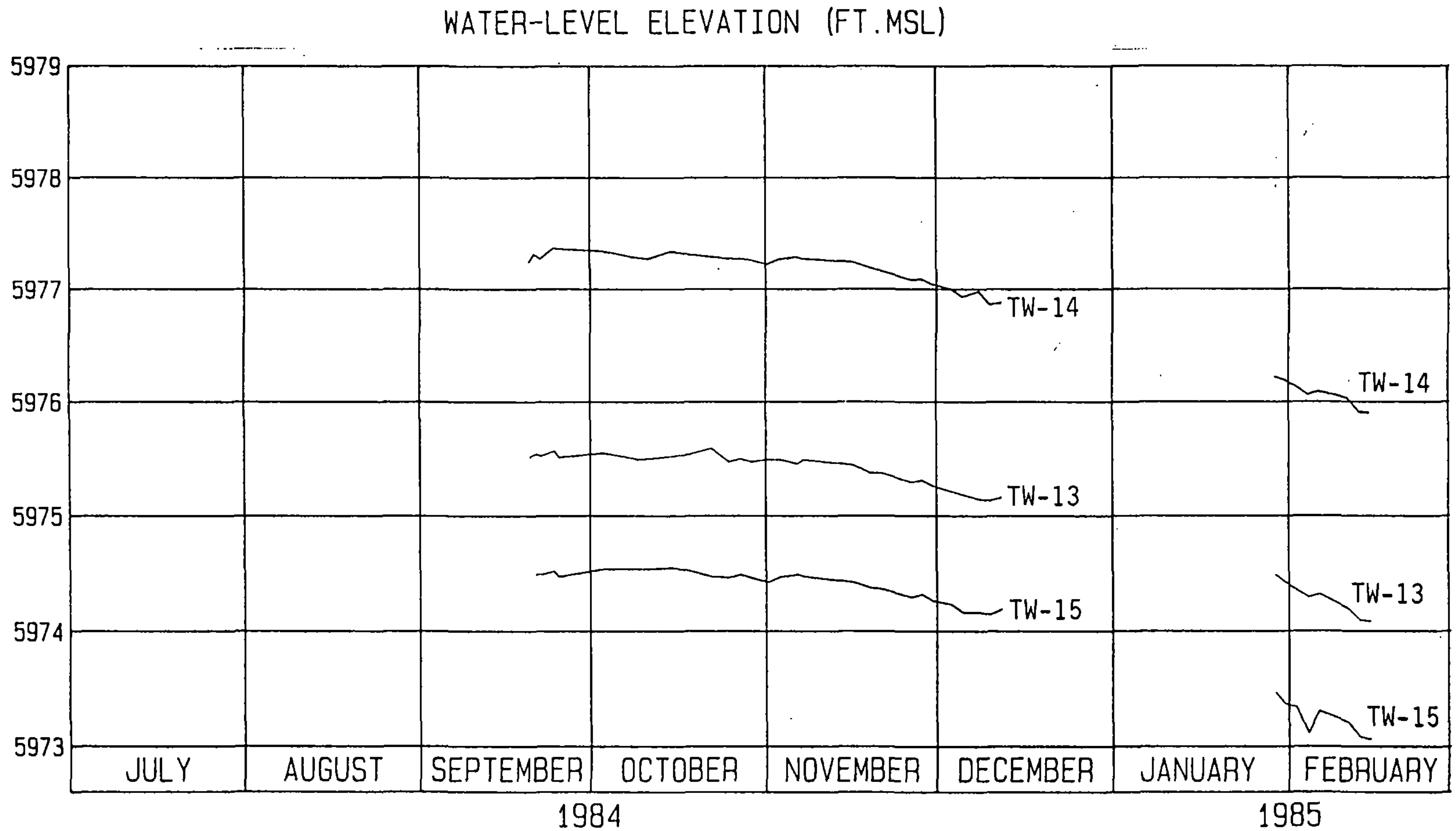
GROUND WATER HYDROGRAPH
MONSANTO TW-11 TW-12

Figure C-5

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED DATE Apr. '85



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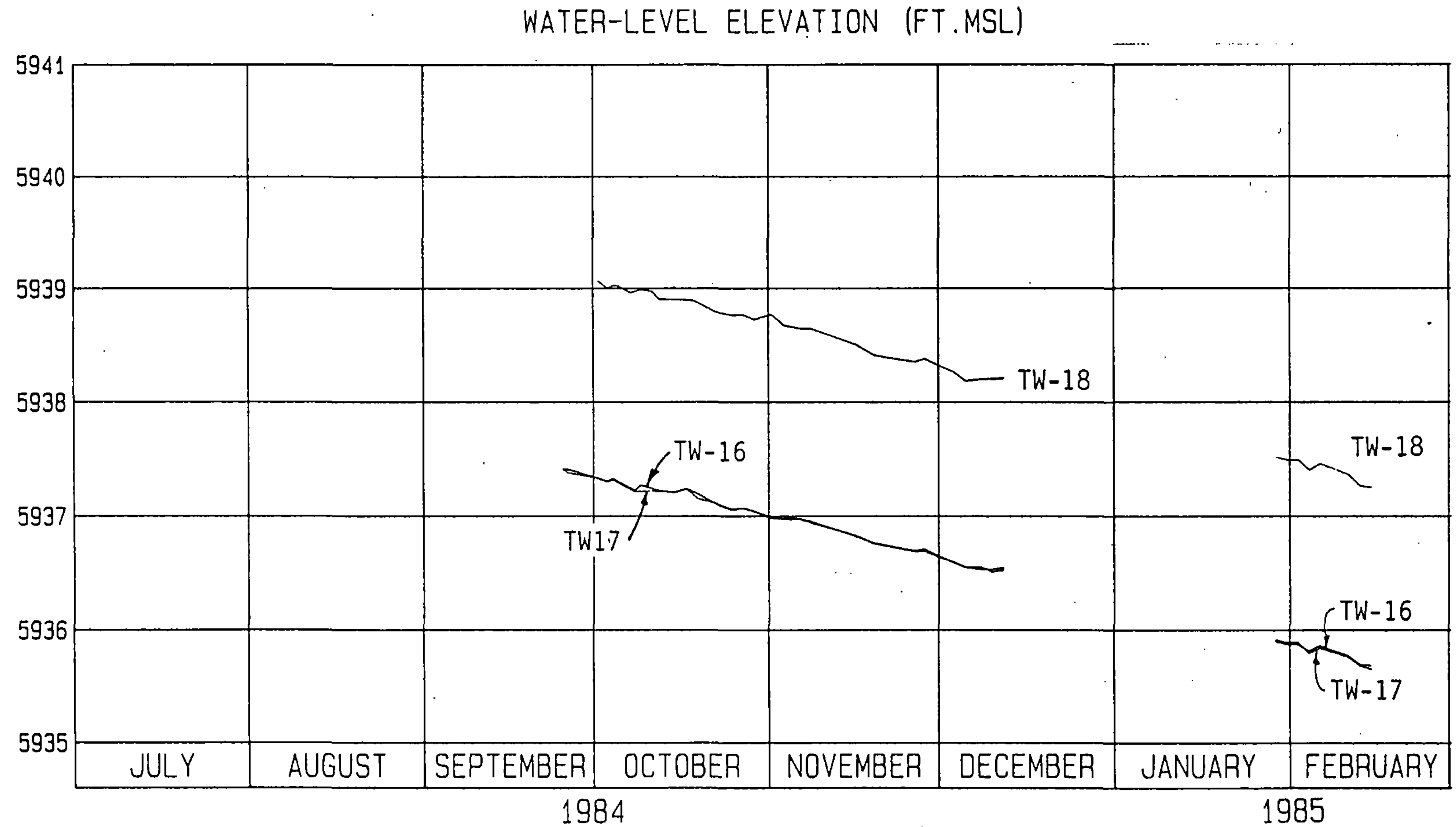
GROUND WATER HYDROGRAPH
MONSANTO TW-13 TW-14 TW-15

Figure C-6

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED DATE Apr. '85



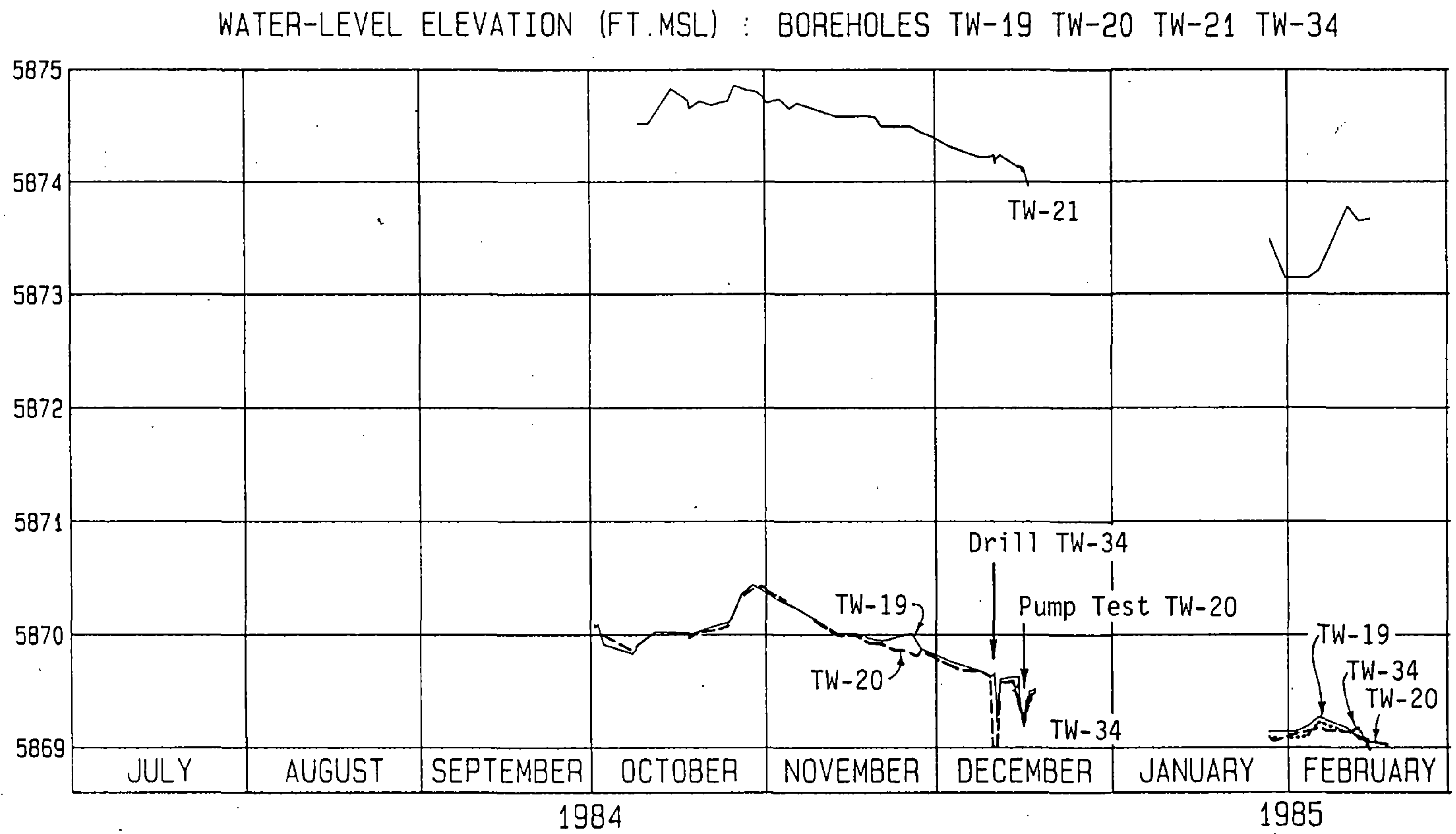
Note: TW-16 and TW-17 record nearly identical water levels.

Golder Associates

GROUND WATER HYDROGRAPH
MONSANTO TW-16 TW-17 TW-18

Figure C-7

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED .... DATE Apr. '85

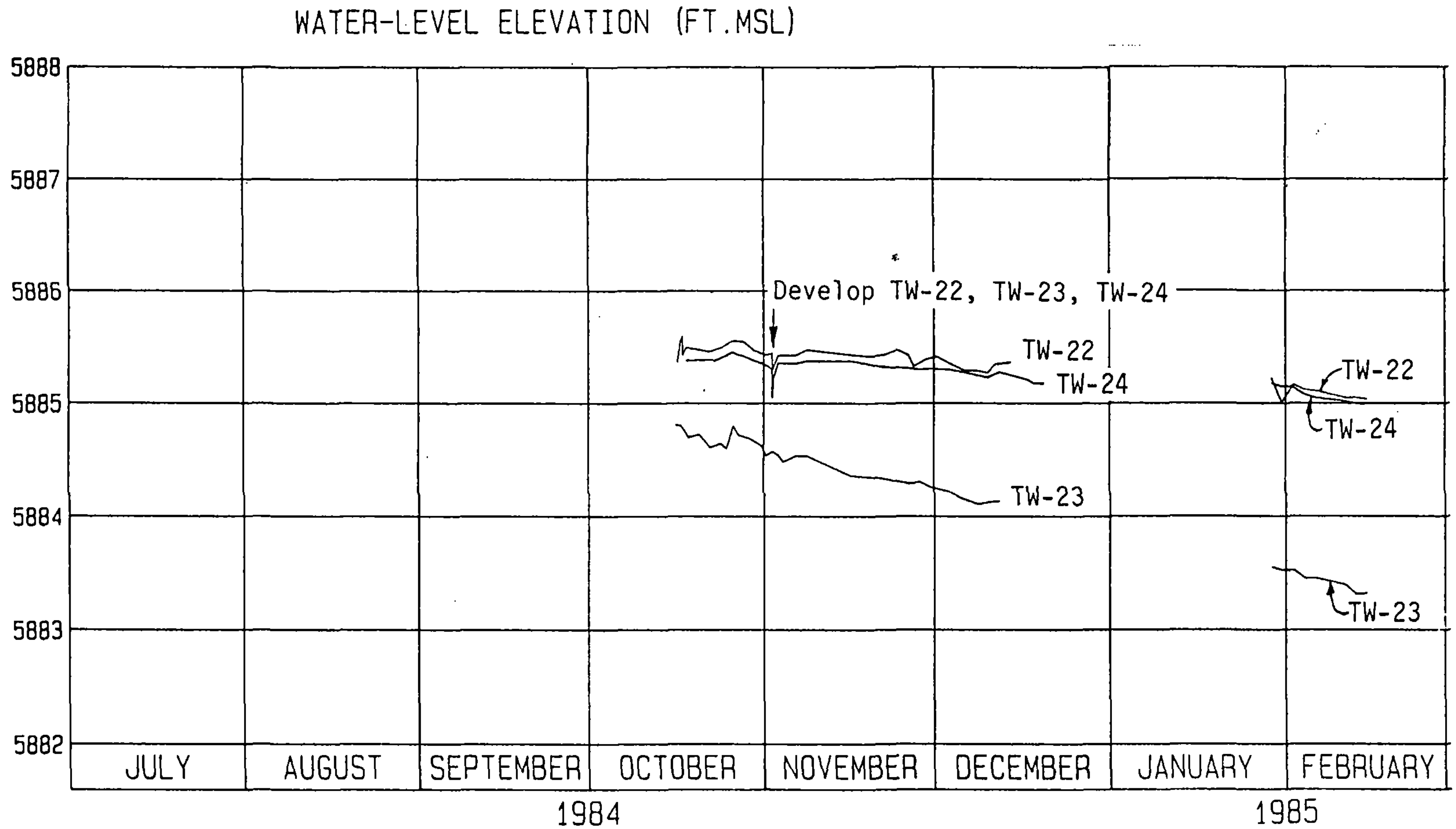


Golder Associates

GROUND WATER HYDROGRAPH
MONSANTO TW-19 TW-20 TW-21 TW34

Figure C-8

PROJECT NO. 842-1543 DRAWN GA. REVIEWED .... DATE Apr. '85



GROUND WATER HYDROGRAPH
MONSANTO TW-22 TW-23 TW-24

Figure **C-9**

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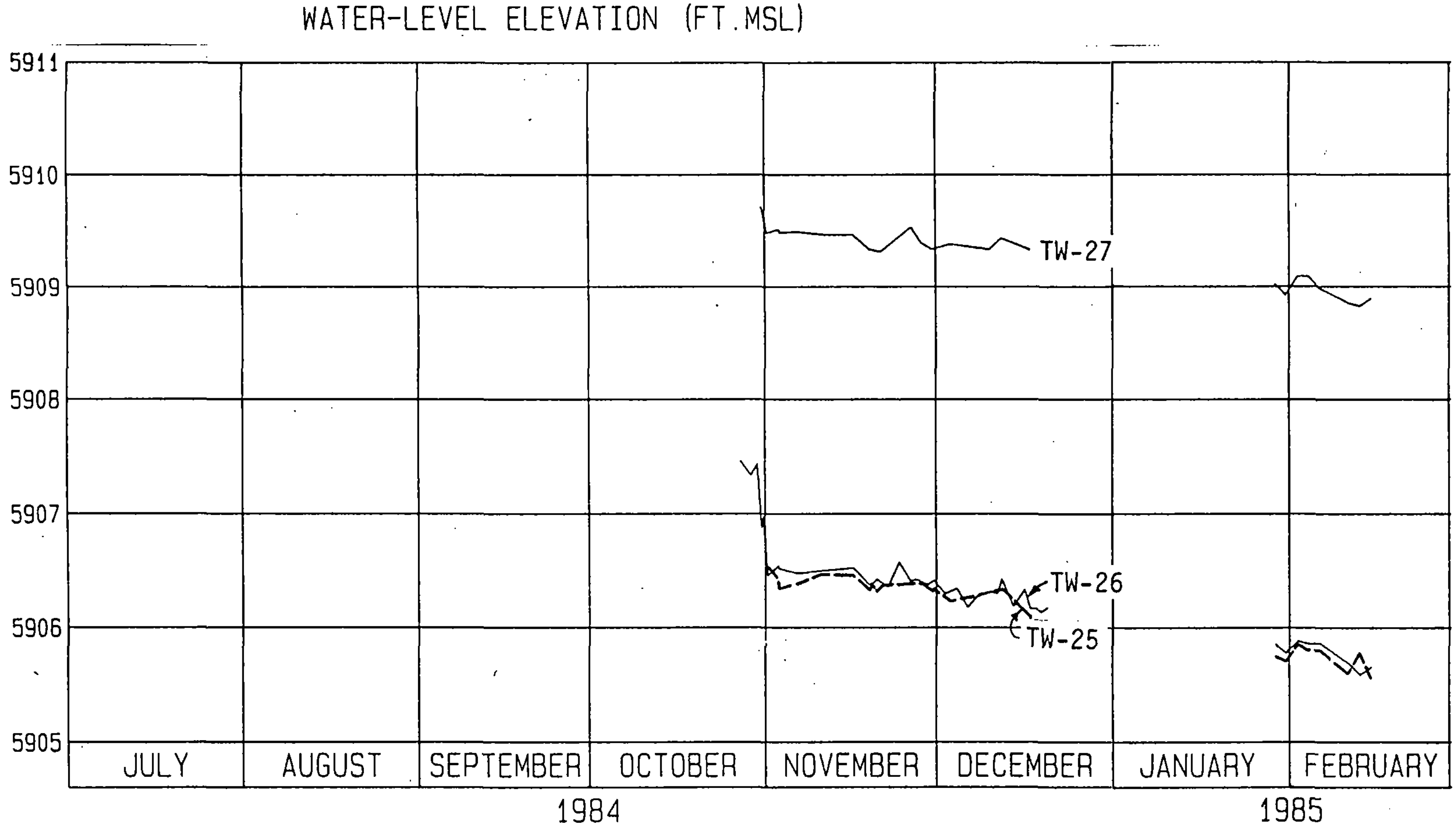
PROJECT NO. 842-1543 DRAWN GA REVIEWED DATE Apr. '85



GROUND WATER HYDROGRAPH
MONSANTO TW-25 TW-26 TW-27

Figure C-10

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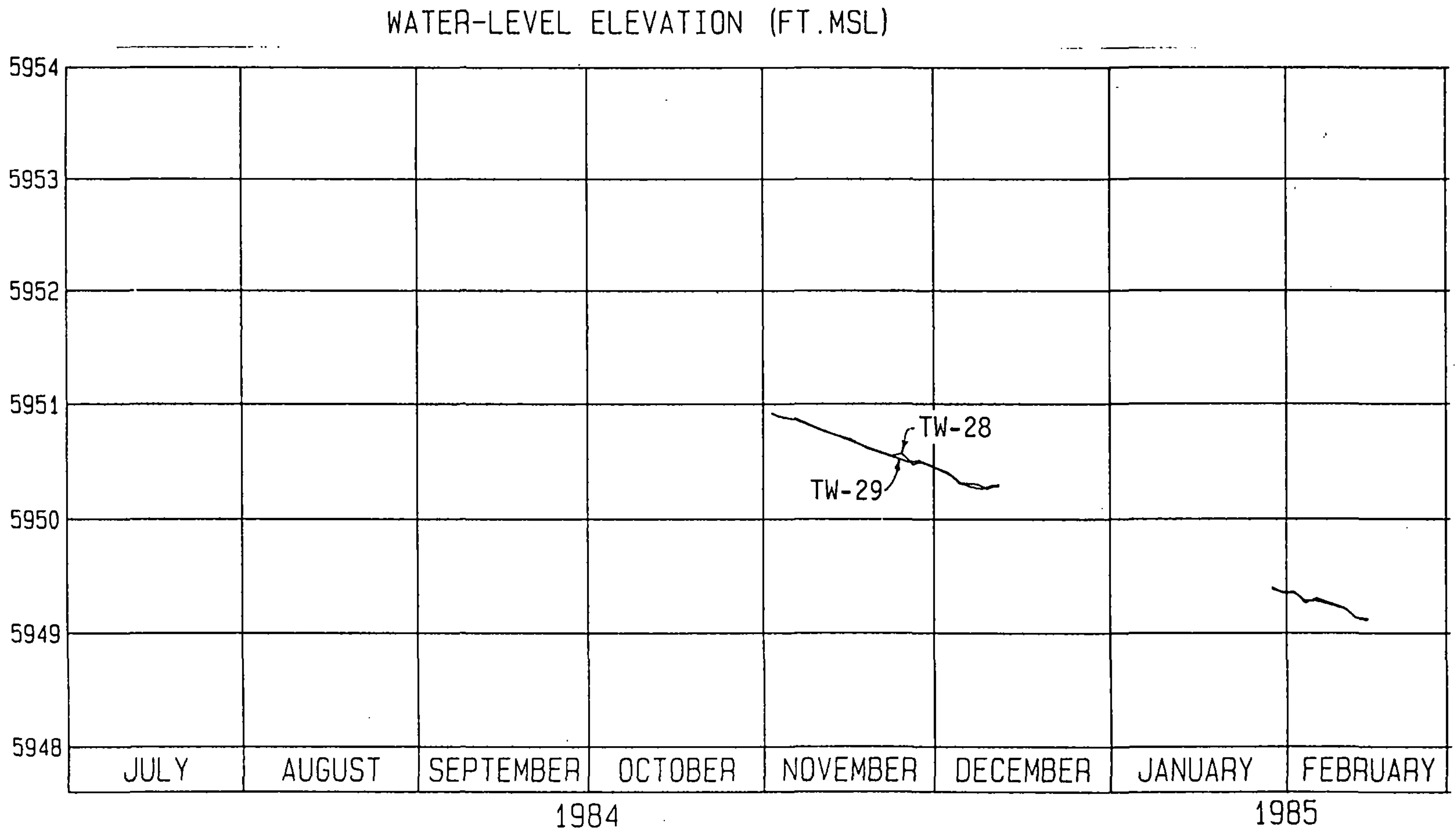
PROJECT NO. 842-1543 DRAWN G.A. REVIEWED DATE Apr. '85



Note: TW-28 TW-29 record nearly identical water levels.

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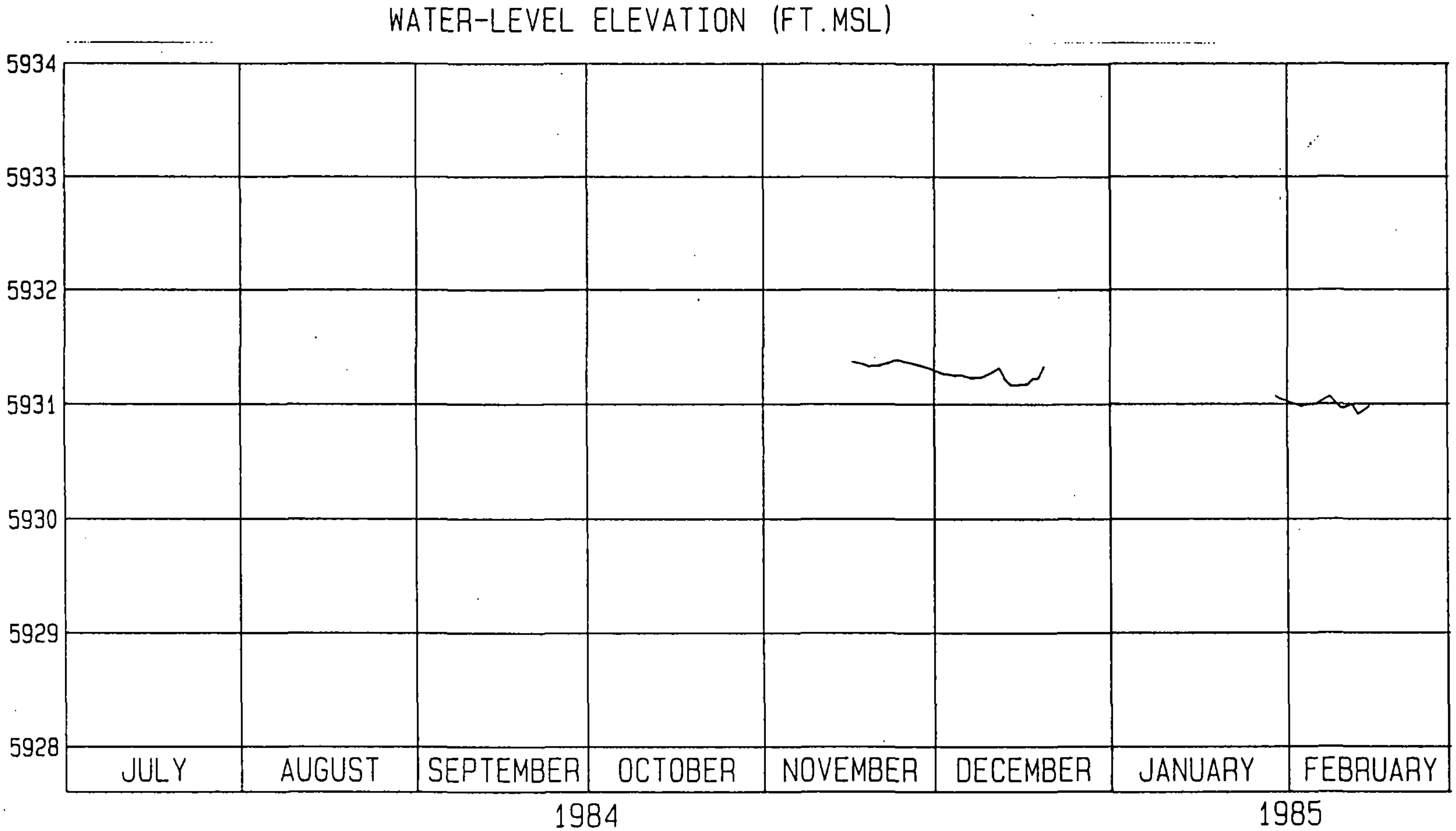
GROUND WATER HYDROGRAPH
MONSANTO TW-28 TW-29

Figure C-11

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED .... DATE Apr. '85



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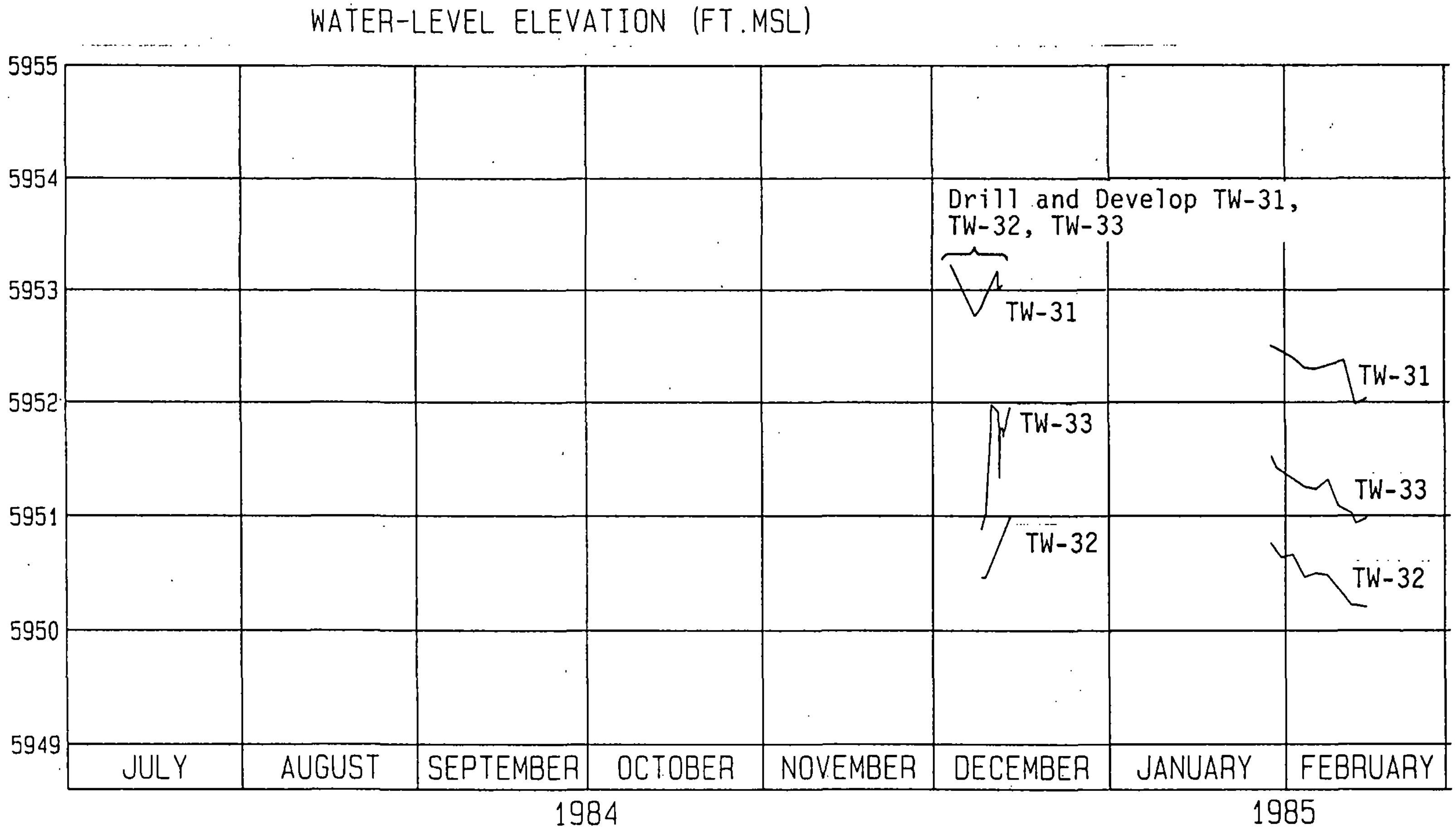
GROUND WATER HYDROGRAPH
MONSANTO TW-30

Figure C-12

PROJECT NO. 842-1543 DRAWN G.A. REVIEWED .... DATE Apr. '85



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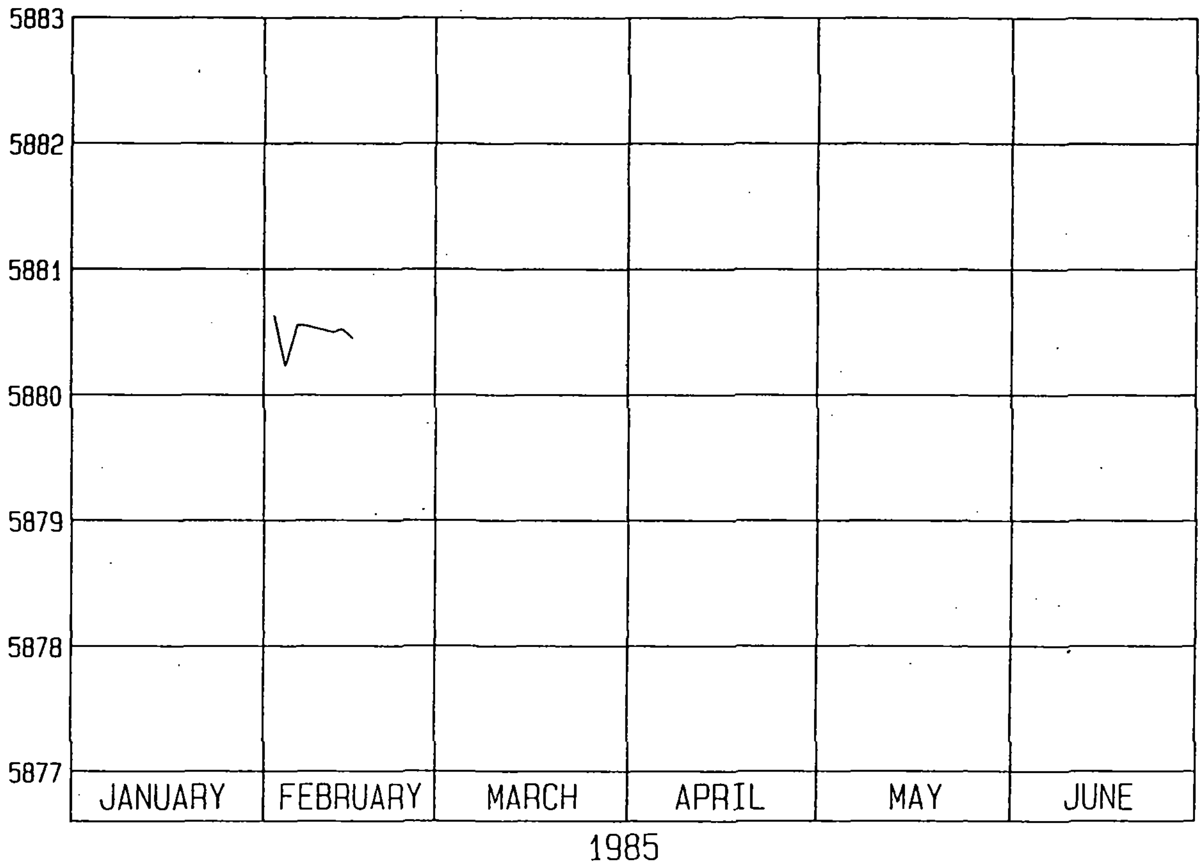
GROUND WATER HYDROGRAPH
MONSANTO TW-31 TW-32 TW-33

Figure C-13

GROUND WATER HYDROGRAPH
MONSANTO TW-36

Figure C-15

WATER-LEVEL ELEVATION (FT.MSL)



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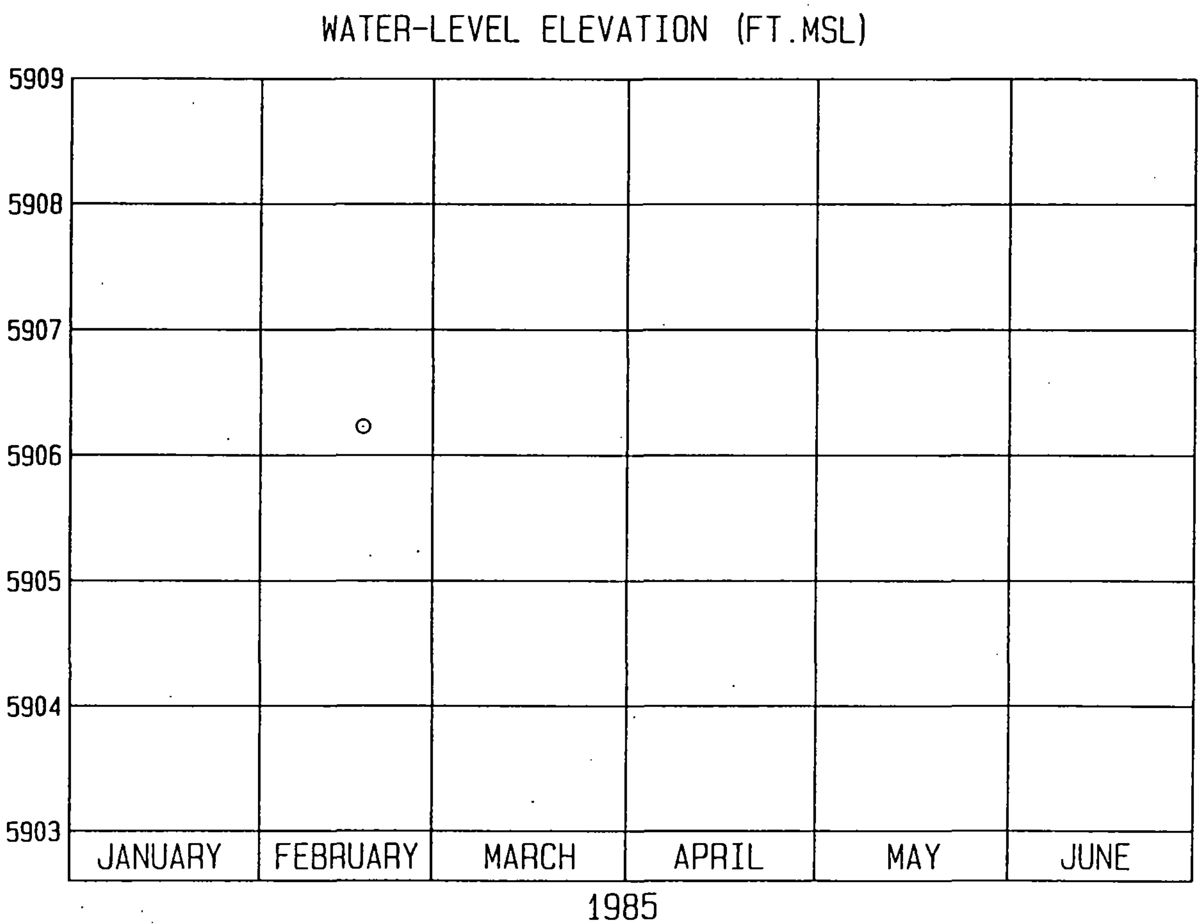
GROUND WATER HYDROGRAPH MONSANTO TW-40	Figure C-17



Note: Water level monitored 3 days
after well completed.

PROJECT NO. 842-1543 DRAWN GA. REVIEWED DATE Apr. '85

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Isometric Fence Diagram
Plate 2

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Plant Site Location Map
Plate 1